Students’ Objectively Measured Physical Activity Levels and Engagement as a Function of Between-Class and Between-Student Differences in Motivation Toward Physical Education

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Despite evidence for the utility of self-determination theory in physical education, few studies used objective indicators of physical activity and mapped out between-class, relative to between-student, differences in physical activity. This study investigated whether moderate-to-vigorous physical activity (MVPA) and rated collective engagement in physical education were associated with autonomous motivation, controlled motivation, and amotivation at the between-class and between-student levels. Participants were 739 pupils (46.3% boys, $M_{age} = 14.36 \pm 1.94$) from 46 secondary school classes in Flanders (Belgium). Multilevel analyses indicated that 37% and 63% of the variance in MVPA was explained by between-student and between-class differences, respectively. Students’ personal autonomous motivation related positively to MVPA. Average autonomous class motivation was positively related to between-class variation in MVPA and collective engagement. Average controlled class motivation and average class amotivation were negatively associated with collective engagement. The findings are discussed in light of self-determination theory’s emphasis on quality of motivation.

Keywords: self-determination theory, physical education, adolescence, physical activity, motivation, engagement

Adopting and maintaining a physically active lifestyle has numerous health benefits, including the prevention of cardiovascular diseases, obesity, cancer, osteoporosis, diabetes type 2, and depression (e.g., Janssen & LeBlanc, 2010). Yet,
adolescents’ physical activity levels have declined over the past two decades (Pate et al., 2006). Particularly, adolescent girls aged 15 to 18 are more at risk for physical inactivity (Bayingana et al., 2006; Sanchez et al., 2007). Because adolescence is considered a critical period for the development of physical inactivity (e.g., Sallis, 2000), there is a strong need for effective strategies to promote physical activity in this age group. Physical education (PE) classes are considered a preeminent forum for promoting physical activity in young people (Fairclough, Stratton, & Baldwin, 2002). One key factor that may determine whether adolescents adopt an active lifestyle is whether they are optimally motivated for PE, that is, whether they enjoy engaging in PE and believe PE is worthwhile (Haerens, Kirk, Cardon, De Bourdeaudhuij, & Vansteenkiste, 2010).

When entering any PE class at secondary school, one would likely observe considerable variation in students’ motivation to participate in the PE course. Some students participate for the activity itself, because they like PE and believe PE is fun, whereas others are less interested and even not motivated. Students’ interpersonal differences in motivation may relate to variation in their physical activity levels during the PE course (Cox, Smith & Williams, 2008; Ntoumanis, 2001). In addition, motivation may also vary from one class to another as a function of factors such as the gender distribution within the class (Lyu & Gill, 2011; Olafson, 2002), the topic of the lesson (Bevans, Fitzpatrick, Sanchez, & Forrest, 2010; Hassandra, Goudas, & Chroni, 2003), the structure of the class environment (Papaioannou, Marsh, & Theodorakis, 2004), and the style of the teacher (Mouratidis, Vansteenkiste, Lens, & Sideridis, 2011). Although it is reasonable to assume that between-class differences in motivation are associated with class-to-class variation in physical activity and engagement—with some classes being more physically active and engaged than others—to our knowledge, no study in the PE context has directly examined this issue. Therefore, the aim of the current study was to examine whether between-student and between-class differences in motivation are related to differences in objectively measured moderate-to-vigorous physical activity (MVPA) and rated engagement during PE class.

Motivational Regulations in the Physical Education Context

Self-determination theory (SDT; Deci & Ryan, 2000; Vansteenkiste, Niemiec, & Soenens, 2010) has been proven to be a useful theoretical framework to study motivational dynamics in the context of PE. Self-determination theory maintains that it is critical to not only take into account the intensity or quantity, but also the quality of motivation when studying human behavior (Vansteenkiste, Lens, & Deci, 2006). Specifically, SDT distinguishes between two broader, qualitatively different forms of motivation, namely, autonomous and controlled.

Autonomous motivation involves the regulation of behavior with the experiences of volition, psychological freedom, and reflective self-endorsement and consists of three subtypes. First, intrinsic motivation refers to engagement in a behavior for its own sake, that is, because the activity is inherently exciting. For instance, an intrinsically motivated student puts effort in a PE exercise because he finds PE enjoyable and challenging. A second form of autonomous motivation
is integrated regulation, which involves engagement in a behavior because the behavior has been brought in alignment with the individual’s other values and ideals. For example, a student engages in PE because she views participating in PE as consistent with her more global values and aspirations in life. Finally, identified regulation operates when students understand the personal significance of the PE activities offered. For instance, a student may take part in the warm-up during PE class because he understands that doing so prevents injuries.

Controlled motivation refers to the pressured engagement in an activity and contains two subtypes. Introjected regulation involves participating in PE to avoid feelings of guilt, shame, and anxiety or to gain pride and ego enhancement. A student who puts effort into PE to demonstrate he is skilled displays introjected regulation. External regulation occurs when students engage in PE to obtain appreciation or rewards or to avoid punishments and criticism. A student who puts effort into PE only to get good grades constitutes an example of external regulation.

Autonomous motivation and controlled motivation are contrasted with amotivation, which exists when people lack intentionality or engage in behaviors for reasons unknown. An amotivated student claims to have no idea why he should bother participating in PE or feels incapable to perform the activities required and thus invests little effort in PE class (Deci & Ryan, 2000).

Between-Student Differences in Motivation in Relation to Physical Activity

Several studies demonstrated that autonomous motivation is associated with higher levels of self-reported physical activity, both during (e.g., Cox et al., 2008; Yli-Piipari, Watt, Jaakkola, Liukkonen, & Nurmi, 2009) and outside the PE class (e.g., Haerens et al., 2010; Taylor, Ntoumanis, Standage, & Spray, 2010). In contrast, controlled forms of motivation and amotivation are usually linked to negative outcomes such as boredom (Ntoumanis, 2001), unhappiness (Standage, Duda, & Pensgaard, 2005), and less or no intentions to participate in physical activity (Standage, Duda, & Ntoumanis, 2003). With respect to physical activity levels, controlled motivation has been found to be unrelated to objective physical activity in the exercise domain (e.g., Standage, Sebire & Loney, 2008). Students may participate in PE activities under the influence of external or self-imposed pressures, such that the negative repercussions of controlled motivation do not manifest at the short term.

A notable lacuna in past SDT-grounded research in the PE domain concerns its almost exclusive reliance on self-reports of physical activity (for an exception, see Lonsdale, Sabiston, Raedeke, Ha, & Sum, 2009). A disadvantage of self-reports is that they are often liable to overestimation of physical activity and are less reliable to determine intensity of physical activity engagement (Wareham & Rennie, 1998). In addition, from a public health perspective, it is essential to collect data on levels of MVPA, given that national (Beunen, De Bourdeaudhuij, Vanden Auweele, & Borms, 2001) and international (e.g., Pate et al., 2006) health guidelines recommend that youth participate in 60 or more minutes of MVPA per day and that students perform MVPA during at least 50% of the effective PE class time (US Department of Health and Human Services, 2000). Hence, there is a strong need for SDT studies that objectively and, hence, more accurately assess students’ MVPA levels in PE.
To date, two studies within the SDT perspective have used pedometers and heart rate monitors to objectively assess students’ physical activity. Lonsdale and colleagues (2009) demonstrated that autonomous motivation for PE predicts students’ step counts during a basketball lesson. Likewise, Jaakkola, Liukkonen, Laakso, and Ommundsen (2008) showed that the average physical activity level of autonomously motivated students was higher and that they exercised more intensively as indicated by a higher heart rate. Consistent with these studies, the present research made use of an objective measure, relying on Actigraph accelerometers, to make more accurate and verifiable estimates of students’ MVPA levels. Although the use of accelerometers is not without limitations, it is currently put forward as a feasible method of choice to objectively assess physical activity in adolescents (Reilly et al., 2008; Rowlands, 2007). Extending the work by Lonsdale et al. (2009) and Jaakkola et al. (2008), the current study examined the role of motivation as a predictor of between-class in addition to between-student differences in both MVPA and rated engagement.

**Examining Class-to-Class Variation in Physical Activity and Engagement**

The motivational atmosphere in a PE class is a product of social interactions among students and teachers (Solmon, 2006) and can differ considerably from one class to another, with resulting differences in behavioral outcomes, such as MVPA. Yet, beside physical activity levels, students’ engagement is another important issue for PE teachers (Skinner & Belmont, 1993; Furrer & Skinner, 2003). In classroom settings, engagement reflects students’ active involvement in a task or activity as can be derived from their attention, effort, verbal participation, persistence and positive emotion (Reeve, Jang, Carrell, Jeon, & Barch, 2004; Skinner, Furrer, Marchand, & Kindermann, 2008). Although engagement is often considered an important determinant of physical activity levels during PE class (Fairclough & Stratton, 2005; Standage et al., 2003), in practice engagement and physical activity do not necessarily go hand in hand. For example, a class can be engaged by arriving in the gymnasium on time, being attentive, and cooperating in the PE course, while not necessarily being highly physically active. In contrast, a class can perform relatively high levels of physical activity, but display disengaged behavior by not asking questions about the activities or by being difficult to handle. Further, for some PE classes, increasing MVPA is not a primary objective (Kirk, 2010), which may lead to lower levels of physical activity, but students may still be highly engaged. Therefore, in the current study, we examined MVPA and engagement as two separate behavioral outcomes.

Class-level factors such as the gender distribution within a class, the PE class topic of the day, and class size (i.e., total number of students in the class) might enhance or diminish activity levels and engagement during PE class. For instance, there is considerable evidence that both physical activity and engagement in PE class are higher in single-sex classes compared with in coeducational classes, especially for girls (e.g., Chow, McKenzie, & Louie, 2009; Lyu & Gill, 2011). With respect to the topic of the PE course, previous research (e.g., Fairclough & Stratton, 2005) has shown that MVPA levels are generally greater during fitness-
oriented activities and team invasion games (e.g., basketball and soccer) when compared with net games (e.g., badminton) and movement activities (e.g., dance and gymnastics). In addition, depending on the specific topic of the PE course, some classes are likely to display more engaged behavior than other classes (Bevans et al., 2010).

Furthermore, between-class differences in MVPA and engagement can also be related to between-class differences in motivation (i.e., average class motivation). Specifically, the average class motivation in one class might be different from the average class motivation in another class, with some classes being as a whole more autonomously motivated for PE, which might relate to higher levels of MVPA and rated engagement at the class level.

**The Present Study**

The purpose of the current study was both descriptive and explanatory in nature. As for the descriptive aim, we began by examining how much of the observed physical activity during PE classes meets the criterion to be classified as moderate to vigorous and whether the health-related recommendations (US Department of Health and Human Services, 2000) are achieved. Second, we investigated how much of the observed variation in students’ physical activity levels and motivation (i.e., autonomous motivation, controlled motivation, and amotivation) is accounted for by between-student and between-class differences.

Our explanatory aim involved examining whether between-student and between-class differences in motivation would relate to MVPA at both levels and whether between-class differences in motivation would relate to rated engagement at the between-class level. As for the between-student differences, given that previous research found female adolescents to be particularly more at risk for physical inactivity during PE class (McKenzie, Marshall, Sallis, & Conway, 2000), we hypothesized that boys would display higher MVPA levels than girls. Further, since autonomous motivation is said to be associated with positive outcomes, we expected autonomous motivation to relate positively to MVPA, whereas amotivation would relate negatively to MVPA. As for controlled motivation, we did not have clear-cut expectations, as students can display physically active behavior during PE class as a result of internal or external demands (Standage et al., 2008).

As for between-class differences, we hypothesized MVPA levels would be greater during fitness-oriented activities and ball games, compared with artistic sports and racket games (Fairclough & Stratton, 2005). In addition, we examined the cross-level interaction between gender and the topic of the PE class because differences between boys and girls in MVPA might be especially pronounced during ball games. Given that no previous study has examined associations of the PE class topic and the gender distribution within the class with collective engagement, this issue was examined in a more explorative fashion. Further, we explored whether class size is related to MVPA and collective engagement. Finally, we expected more autonomously motivated classes to display higher levels of MVPA and engagement during PE class, whereas MVPA and engagement would be lower in classes characterized by higher levels of controlled motivation and amotivation.
Methods

Participants

Participants were 739 students (342 boys; 46.3%) from 46 classes out of 29 high schools in Flanders. Students had a mean age of 14.36 years ($SD = 1.94$, range 11–19 years). All participants attended secondary education schools with 73.1% enrolled in academic education, 23.1% in technical education, and 3.8% in vocational education. Students belonged to coeducational PE classes, with each class containing on average 16 students (range from 3 to 23). Each PE class was taught by a different teacher. The 46 PE teachers (60.9% male) were on average 38.87 years old ($SD = 11.23$) with 16.07 years of teaching experience ($SD = 11.50$). The topic of the PE course was determined by the PE teacher, and the topics were grouped according to their common characteristics in one of four categories (Fairclough & Stratton, 2005): ball games (e.g., basketball, soccer, baseball; 22 classes, or 47.8%), artistic sports (e.g., gymnastics, dance, rope skipping; 16 classes, or 34.8%), fitness training (e.g., running, fitness track, power training; 5 classes, or 11.8%), and racket games (badminton, table tennis; 3 classes, or 8.3%). Although one class hour usually lasts for 50 min, in practice the average effective class time lasted for somewhat more than 35 min ($M = 36.9 \pm 13.3$), because the students were switching clothing and putting on the accelerometer.

Procedure

In Flanders, PE is a compulsory subject for all secondary school students. Generally, the PE curriculum comprises blocks of the same activities for six to ten consecutive weeks. Teachers were asked to give their PE lesson as planned. Before the study, teachers were informed about the planned measurements and all teachers gave approval to participate in the study by means of informed consents. In addition, the parents of all students received an informed consent form in which authorization was asked for their child’s study participation. The study protocol was approved by the Ethical Committee of Ghent University.

Physical education classes were videotaped using digital camcorders. The camcorder was positioned by research assistants on a fixed spot in the gymnasium before the PE class started. The camcorder was set up in a way as to capture a large viewing angle such that all students and the PE teacher could be simultaneously recorded. The first few minutes of the videotape were considered pilot data to reduce the influence of participant reactivity (Elder, 1999). Before the PE class started, accelerometers were randomly distributed among the students, as the number of available devices was limited ($M = 12$ per class). Participants wore the accelerometer beneath their clothing using an elastic belt with adjustable buckle attached on the hip. The research assistants carefully checked whether the devices were held closely against the students’ bodies to prevent erroneous readings. Although one may argue that the use of accelerometers and videotaping may have prompted students to become more active and engaged, it should be noted that both the students and the teacher were blind to the study purpose and the exact hypotheses being tested. At the end of the lesson, students were asked to independently fill out a set of questionnaires about the past PE class.
Motivation and Objective Physical Activity in PE

Measures

Behavioral Regulations in Physical Education Questionnaire (BRPEQ). An adapted Dutch version of the Behavioral Regulations in Exercise Questionnaire (BREQ-II; Markland & Tobin, 2004) was employed to measure autonomous motivation, controlled motivation, and amotivation toward PE class using the following stem: “I put effort in this physical education class because...” For the purposes of the present research, several items of the original BREQ-II were adjusted to the context of PE and the questionnaire was renamed as the Behavioral Regulations in Physical Education Questionnaire (BRPEQ). These changes primarily involved removing the reference to exercising. Two somewhat more substantial changes were made. First, as pilot testing pointed out that an item with double negations was confusing, we adapted the item from “because others will not be pleased with me if I don’t” into “because it is the only way to please others” (external regulation). Second, the item “because it is important to me to exercise regularly” was changed into “because it is personally important to me” (identified regulation) because SDT emphasizes the personal endorsement rather than the more general importance of activity engagement (Vansteenkiste, Lens, De Witte, & Feather, 2005). Finally, six additional items were formulated to obtain an optimal balance in controlled regulation items being characterized by an avoidance and approach orientation (Assor, Vansteenkiste, & Kaplan, 2009). Because most of the items in the original introjected regulation scale of the BREQ-II yield a reference to avoiding a negative state (e.g., “because I would feel guilty otherwise”), it remains unclear whether the observed correlates of introjected regulation are due to its pressuring or avoidance-oriented character, as both are contaminated. Therefore, we added three approach-oriented items (i.e., “because it is the only way to be self-satisfied,” “because I have to prove myself,” and “because it is the only way to be proud of myself”) in the case of introjected regulation. As for external regulation, two avoidance-oriented items (i.e., “because I otherwise get criticized” and “because others will appreciate me less”) were added given that the original subscale primarily contains approach-oriented items (e.g., “because it is the only way to please others”). Finally, we added one identified regulation item (i.e., “because I fully recognize the usefulness of this course”). Integrated regulation is not measured by the BREQ-II, because integrated regulation requires a high degree of introspection and self-awareness and is hardly empirically distinguishable from identified and intrinsic regulation through self-reports in children and adolescents (Brickell & Chatzisarantis, 2007). The original items for amotivation (e.g., “I actually found the past PE course a waste of time”) and intrinsic motivation (e.g., “because I enjoyed the PE course”) were maintained in the adapted 25-item BRPEQ version. Items were rated on a 5-point Likert scale from 1 (not true for me) to 5 (very true for me).

In a pilot sample of 387 secondary school students from 30 classes (50.9% boys, $M_{age}=15.04 \pm 4.93$), these 25 items were subjected to an exploratory factor analysis (EFA) relying on a maximum likelihood extraction method with promax rotation. The Kaiser–Meyer–Olkin (KMO) measure verified the sampling adequacy for the analysis, KMO = .91, and all KMO values for individual items were > .82, which is well above the limit of .50 (Field, 2009). Based on conceptual (e.g., a balanced number of approach-oriented and avoidance-oriented items), pragmatic (e.g., an equal number of items per subcategory), and empirical grounds, we retained 20
items, representing the five motivational subscales, each being assessed with four items (see Appendix). An EFA on these 20 items yielded three factors with an eigenvalue above 1 (i.e., 5.69, 4.93, and 1.13), explaining 58.76% of the variance in the motivation items. After promax rotation, these three factors could easily be interpreted as representing autonomous motivation, controlled motivation, and amotivation. Although the majority of the items loaded on its intended theoretical factor, one exception could be noticed. The item “I actually found the past PE course a waste of time” loaded on its original amotivation factor (.36), and also loaded negatively on the factor tapping into autonomous motivation (–.44). However, the original theoretical structure of the BRPEQ was used for further analyses.

Next, to further test the three-factor structure on the individual level after taking out the shared variance due to classroom effect, a multilevel confirmatory factor analysis (CFA) as recommended by Hox (2010) was performed with the aid of Mplus 5.1 (Muthén & Muthén, 2007) combined with EQS 6.1 (Bentler, 2005) software. At the individual level the three-factor solution for the BRPEQ yielded the following fit indices, $\chi^2 (167; N = 723) = 768.42; p < .01$, $CFI = .902$, $SRMR = .083$, $RMSEA = .071$ (90% CI: .066–.076). These results provide further evidence for the fact that participants differentiate between autonomous, controlled, and amotivated reasons.

Internal consistencies were satisfactory with Cronbach’s alphas of .90, .84, and .82 for autonomous motivation, controlled motivation, and amotivation, respectively ($\alpha = .89, .82, \text{and} .80$ after partialing out the shared variance due to classroom effect). Given these results, we created, similar to previous research (e.g., Haerens et al., 2010), composite scores of autonomous motivation, controlled motivation, and amotivation by averaging the items. Consistent with previous research (e.g., Haerens et al., 2010; Standage et al., 2008) and in line with the idea that these three regulatory styles fall along a continuum of increasing autonomy and volition, autonomous and amotivation were found to be negatively correlated, $r(739) = -.41, p < .01$, whereas autonomous and controlled motivation correlated slightly positively: $r(739) = .10, p < .05$. Further, controlled motivation and amotivation were positively correlated, $r(739) = .49, p < .01$. The correlations between the latent factors when multilevel CFA is considered were, respectively, $r = -.52, p < .01; r = -.08, p = .06; \text{and} r = .65, p < .01$.

**Physical Activity Levels.** Physical activity levels were assessed using three types of CSA Actigraph monitors (Computer Science Application, Inc., Shalimar, FL): Actigraph model 7164, GT1M and GT3× accelerometers. The Actigraph 7164 uses a unidirectional accelerometer that measures accelerations in the vertical plane, whereas the GT1M and GT3× include an omnidirectional accelerometer, which is sensitive to movement in all directions. To be able to compare accelerometer data from the different types of devices, only vertical accelerations of the omniaxial devices were taken into account. Actigraph accelerometers have been widely used in research and are considered the best choice to objectively assess physical activity in children (Reilly et al., 2008; Trost, Way, & Okely, 2006).

In our sample, 554 randomly selected participants (75%) wore an accelerometer during PE class. There were no differences between students wearing an accelerometer and those not wearing one in terms of autonomous motivation, $\beta = .14, S.E. = .08 (\chi^2 = 3.45, df = 1, ns)$; controlled motivation, $\beta = -.02, S.E. = .06 (\chi^2 = .15, df = 1, ns)$.
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Engagement. Based on videotapes of all PE classes, trained observers rated students’ overall engagement using five items to be rated on a scale from 0 (never) to 3 (always). After having watched the full videotapes, one of three trained observers assigned a single class-level score to each of the five items. Subsequently, the five engagement items were averaged as a single collective engagement score. We used a well-validated and frequently used scale from Reeve et al. (2004), which contained the following items: “The students pay attention during this PE class,” “The students put effort in the activities and exercises,” “The students ask questions about the exercises,” “The students don’t give up easily during challenging tasks,” and “The students seem to enjoy this PE class.” Two master-level physical educators and one motivational psychologist were trained during two group meetings in which each of the observers separately coded two PE classes on the five engagement items. Problems or doubts raised during the coding process were registered and discrepancies in interpretation of the items were discussed. All three observers independently coded the same 20 videotapes to assess interrater reliability, whereas one observer coded 10 lessons twice 2 weeks apart to assess intrarater reliability. Interrater and intrarater reliabilities were calculated by means of intraclass correlation coefficients (ICC), thereby using a two-way random model. Although limits for levels of reliability are fairly arbitrary, values below .50 are considered as poor, whereas values from .50 to .75 and above .75 are considered as moderate and good, respectively (Portney & Watkins, 2009, p. 82). In the current study, interrater (ICC = .79) and intrarater (ICC = .90) reliability for collective engagement were good.

Analyses

Given the nested structure of the data, with 739 students nested within 46 classes (or teachers) nested within 29 schools, and the adequate sample size for conducting multilevel analyses (Maas & Hox, 2005), multilevel regression analyses were employed. As the school- and class-level were largely confounded (i.e., for 18 out of the 29 schools the number of teachers per school is n = 1), the estimation of a
three-level model does not seem justified. Moreover, a three-level model did not yield a better fit than a two-level model ($\chi^2 = 1.822, df = 1, ns$) and the random part of the null model showed that the variance at the school level is not significantly different from zero ($\chi^2 = .897, df = 1, p = .34$). Therefore, the data were treated as a two-level model, consisting of students at the first level and classes (or teachers) at the second level. In the present data analyses, a baseline variance components model (Rasbash, Steele, Browne, & Goldstein, 2009) or intercept-only model (Hox, 2010) was used to evaluate how much of the variation in MVPA could be attributed to both levels. Since engagement was a class-level variable, we relied on simple regression analyses. Although data on students’ MVPA levels were not available for all participants, the occurrence of missing data does not constitute a problem for multilevel models analyses because the software automatically takes missings into account by running the analyses with MVPA as the dependent variable on 554 out of 739 students. All regression analyses were conducted using MLWiN version 2.20 (Rasbash et al., 2009).

With respect to the descriptive aim, we began by investigating the prevalence rates for achieving the health-related recommendation of performing MVPA during at least 50% of the effective PE class time (US Department of Health and Human Services, 2000). Prevalence rates were derived from cross-tabulation outputs, relying on PASW 18.0 software. Second, a two-level null model for MVPA and all measured types of motivation (i.e., autonomous, controlled, and amotivation), with only an intercept and no explanatory variables, was estimated. This null model partitions the total variance of the examined variable into the between-student (Level 1) and between-class (Level 2) variance. The MVPA null model further served as a baseline with which to compare subsequent more complex models in the second step (i.e., explanatory aim) of our analyses. With regard to engagement, there was no need to estimate the variance at both levels, since engagement was solely rated at the class level.

With respect to the explanatory aim, analyses involved the stepwise insertion of both student-level (i.e., student gender, personal motivation) and class-level (i.e., PE class topic, class size, average class motivation) variables in the prediction of MVPA during PE class. Because student gender, PE class topic, and class size were considered as background variables, these predictors were entered in the models before motivation scores. Given that engagement was rated at the class level, we only investigated the predictive value of class-level factors.

**Results**

**Aim 1: Descriptive Statistics**

**Moderate-to-Vigorous Physical Activity.** First, the prevalence rates for achieving the recommended amounts of MVPA during PE class time were fairly low, with only 12.8% of the students (18.8% of the boys and 7.9% of the girls) scoring equal to or above 50%. Second, a fully unconditional two-level null model for MVPA was estimated. The intercept of 25.20 (S.E. = 2.15) refers to the overall mean of MVPA scores of all students across all classes, suggesting that students perform MVPA during on average 25% of effective PE class time. The random part of the
null model reveals that the variances at the student ($\chi^2 = 253.98$, $df = 1$, $p < .001$) and class ($\chi^2 = 20.71$, $df = 1$, $p < .001$) level are statistically significant from zero, hence providing justification for using multilevel models. Specifically, 37% and 63% of the variability in MVPA scores can be accounted for by between-student and between-class differences, respectively.

**Motivation.** Similarly, a two-level null model for autonomous motivation, controlled motivation, and amotivation was estimated, yielding intercepts of 3.51 ($S.E. = 0.05$), 1.84 ($S.E. = 0.05$), and 1.74 ($S.E. = 0.05$) respectively. The random parts of the null models show that for all three motivational variables, variances at both the student and class level are statistically significant from zero. Student-level variance largely exceeds the class-level variance, being respectively 90% ($\chi^2 = 8.79$, $df = 1$, $p = .003$) and 10% ($\chi^2 = 340.93$, $df = 1$, $p < .001$) for autonomous motivation, 87% ($\chi^2 = 11.02$, $df = 1$, $p = .001$) and 13% ($\chi^2 = 340.72$, $df = 1$, $p < .001$) for controlled motivation, and 90% ($\chi^2 = 8.83$, $df = 1$, $p = .003$) and 10% ($\chi^2 = 339.88$, $df = 1$, $p < .001$) for amotivation.

**Aim 2: Correlates of Moderate-to-Vigorous Physical Activity and Engagement**

In a second step, we investigated whether MVPA and engagement differ as a function of student- and/or class-level predictors by entering these explanatory variables in a stepwise fashion into two separate test models.

**Moderate-to-Vigorous Physical Activity.** First, as can be noticed in Table 1 (see Model 1), the inclusion of student gender significantly ameliorated the model. Boys had significantly higher MVPA levels than girls ($\chi^2 = 33.13$, $df = 1$, $p < .001$), with boys displaying MVPA during 28.34% ($S.E. = 2.15$) and girls during 22.62% ($S.E. = 2.13$) of the effective class time. The random part of the test model indicates that student gender explains 6% of the between-student differences.

To gain insight into the role of the PE class topic, this variable was added to the fixed part of Model 1. Three dummies were created with artistic sports, fitness training, and racket games being contrasted against ball games, which served as the reference group. As shown in Table 1 (see Model 2), our findings point to a main effect of the PE class topic on MVPA. To find out which types of PE activities significantly differed from each other, all possible group comparisons were performed by changing the reference group. Specifically, the left part of Table 2 shows that students were significantly less active during racket games compared with all other PE activities (ball games, $\chi^2 = 6.29$, $df = 1$, $p < .05$; artistic sports, $\chi^2 = 4.03$, $df = 1$, $p < .05$; fitness training, $\chi^2 = 9.22$, $df = 1$, $p < .01$). Physical activity levels during artistic sports ($\chi^2 = 0.71$, $df = 1$, $ns$) and fitness training ($\chi^2 = 1.85$, $df = 1$, $ns$) were not statistically different from activity levels during ball games and activity levels in artistic sports further did not differ from activity levels during fitness training ($\chi^2 = 3.45$, $df = 1$, $ns$). The random part of the model reveals that the kind of activities offered accounts for approximately 19% of the between-class variance in MVPA.

We further explored the cross-level interaction between student gender (Level 1) and the topic of the PE class (Level 2). In the interaction model (Model 3 in Table 1), the intercept reflects the coefficient for boys during ball games.
Table 1  Summary of the Model Estimates for the Two-Level Analyses of MVPA Scores (Percentage of Class Time)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Model 0</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
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<tr>
<td>Intercept</td>
<td>25.20 (2.15)</td>
<td>28.34 (2.15)</td>
<td>29.89 (2.79)</td>
<td>32.40 (2.86)</td>
<td>32.69 (2.92)</td>
<td>32.43 (2.86)</td>
<td>32.82 (2.58)</td>
</tr>
<tr>
<td>Student gender (girl)</td>
<td>-5.72 (.99)***</td>
<td>-5.64 (.99)***</td>
<td>-10.29 (1.39)***</td>
<td>-10.28 (1.39)***</td>
<td>-10.19 (1.39)***</td>
<td>-10.27 (1.39)***</td>
<td></td>
</tr>
<tr>
<td>Artistic sportsb</td>
<td>-3.56 (4.22)</td>
<td>-8.77 (4.43)*</td>
<td>-8.57 (4.44)</td>
<td>-8.24 (4.36)</td>
<td>-9.10 (3.97)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fitness training</td>
<td>8.58 (6.32)</td>
<td>3.37 (6.51)</td>
<td>3.07 (6.53)</td>
<td>3.26 (6.40)</td>
<td>.86 (5.70)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Racket games</td>
<td>-19.69 (7.85)*</td>
<td>-20.10 (8.53)*</td>
<td>-21.09 (8.74)*</td>
<td>-20.04 (8.57)*</td>
<td>-17.76 (7.98)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girl × Artistic sports</td>
<td>9.39 (2.19)***</td>
<td>9.41 (2.19)***</td>
<td>8.82 (2.18)***</td>
<td>9.14 (2.18)***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girl × Fitness training</td>
<td>11.60 (3.05)***</td>
<td>11.57 (3.05)***</td>
<td>11.37 (3.03)***</td>
<td>11.38 (3.03)***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girl × Racket games</td>
<td>1.95 (4.17)</td>
<td>1.95 (4.17)</td>
<td>1.34 (4.11)</td>
<td>1.46 (4.11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class size</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.23 (.46)</td>
<td>.20 (.45)</td>
<td>-23 (.42)</td>
</tr>
<tr>
<td>Personal autonomous motivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.84 (.62)**</td>
<td>1.68 (.62)**</td>
<td></td>
</tr>
<tr>
<td>Personal controlled motivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.71 (.78)</td>
<td>-.73 (.79)</td>
<td></td>
</tr>
<tr>
<td>Personal amotivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.09 (.71)</td>
<td>-.09 (.71)</td>
<td></td>
</tr>
<tr>
<td>Average autonomous class</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.52 (6.60)**</td>
</tr>
<tr>
<td>motivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average controlled class</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-8.99 (8.72)</td>
</tr>
<tr>
<td>motivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average class amotivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.15 (8.30)</td>
</tr>
<tr>
<td>Random Part</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class-level variance</td>
<td>200.73 (44.11)</td>
<td>189.27 (41.60)</td>
<td>153.94 (34.22)</td>
<td>157.81 (34.94)</td>
<td>157.10 (34.78)</td>
<td>150.49 (33.39)</td>
<td>111.54 (25.25)</td>
</tr>
<tr>
<td>Student-level variance</td>
<td>120.17 (7.54)</td>
<td>113.40 (7.12)</td>
<td>113.39 (7.12)</td>
<td>107.68 (6.76)</td>
<td>107.67 (6.76)</td>
<td>103.19 (6.55)</td>
<td>103.15 (6.54)</td>
</tr>
<tr>
<td>Deviance test model</td>
<td>4363.80</td>
<td>4331.63</td>
<td>4322.63</td>
<td>4297.33</td>
<td>4297.07</td>
<td>4190.32</td>
<td>4177.30</td>
</tr>
<tr>
<td>$\chi^2 (df)$</td>
<td>32.17 (1)***</td>
<td>9.00 (3)</td>
<td>25.30 (3)***</td>
<td>.26 (1)</td>
<td>106.75 (3)***</td>
<td>13.02 (3)***</td>
<td></td>
</tr>
</tbody>
</table>

Note. Values in parentheses are standard errors. *p < .05; **p < .01; ***p < .001.

* 0 = boy, 1 = girl; reference category = boy; b 1 = ball games, 2 = artistic sports, 3 = fitness training, 4 = racket games; reference category = ball games.

Intercept Model 1 represents the mean MVPA score for boys; intercept Model 2 represents the mean MVPA score during ball games; intercept Model 3 represents the mean MVPA score for boys during ball games, and so on.
Table 2  Means and Standard Deviations in MVPA scores (Percentage of Class Time) as a Function of Student Gender and PE Class Topic

<table>
<thead>
<tr>
<th>Topic PE class</th>
<th>Topic by Gender</th>
<th>Topic</th>
<th>M (SD)</th>
<th>Boys M (SD)</th>
<th>Girls M (SD)</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ball games</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boys</td>
<td>32.40 (2.86)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Girls</td>
<td>22.11 (2.84)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>–10.29***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artistic sports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boys</td>
<td>23.63 (3.39)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Girls</td>
<td>22.73 (3.33)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>–0.90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fitness training</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boys</td>
<td>35.77 (5.85)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Girls</td>
<td>37.08 (5.99)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>1.31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Racket games</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boys</td>
<td>12.30 (8.04)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Girls</td>
<td>3.96 (7.49)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>–8.34*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. Values in parentheses are standard errors. *p < .05; **p < .01; ***p < .001. Regression equations were repeated several times by changing the reference category to obtain coefficients for all combinations of gender and PE class topic.

* Differences in MVPA levels during ball games, artistic sports, and fitness training are not statistically significant; b MVPA levels are significantly lower during racket games compared with ball games, artistic sports and fitness training.

The student gender slope refers to a class were ball games are taught, whereas the PE class topic slope refers to student gender = 0, which are boys. To interpret the significant cross-level interaction, the regression equations were repeated several times by changing the reference category to obtain coefficients for all combinations of gender and PE class topic. The results presented in the right part of Table 2 point to significantly higher MVPA levels among boys, relative to girls, during ball games and racket games, whereas no gender differences were found for artistic sports and fitness training. This suggests that the main effect of student gender should be interpreted with caution, as the gender differences do not emerge across all PE class topics.

The addition of class size (see Model 4 in Table 1) did not produce a significantly ameliorated model (χ² = .26, df = 1, ns). In a next step, a multiple predictor model (Model 5 in Table 1) was tested, including personal autonomous motivation, personal controlled motivation, and personal amotivation. To facilitate the interpretation of the variances of intercepts and slopes, all three motivational explanatory variables were centered on their overall mean. As such, the intercepts, slopes, and variances were to be interpreted as values for the “average” student (Hox, 2010). Personal autonomous motivation (but not personal controlled motivation neither personal amotivation) was positively associated with MVPA, indicating that autonomously motivated students were more physically active during PE class. The random part of the model reveals that personal motivation accounts for 4% of the between-student differences in MVPA.

Finally, we examined whether MVPA levels would vary as a function of the average class motivation (i.e., contextual effect). Therefore, three class-level predictors were constructed by calculating an average autonomous motivation, controlled motivation, and amotivation score for students belonging to the same class. The inclusion of these three class-level motivational variables significantly
ameliorated the test model (Model 6 in Table 1), together accounting for about 26% of the between-class variance in MVPA. A higher average autonomous class motivation was related to higher levels of MVPA, irrespective of pupils’ personal autonomous motivation scores. Average controlled class motivation and average class amotivation were not significantly related to MVPA.

**Engagement.** With regard to collective engagement, engagement scores differed as a function of the gender distribution across classes (see Model 1 in Table 3), with classes including a higher percentage of boys being more engaged during PE class. Gender distribution accounts for about 2% of the between-class differences in collective engagement.

In addition, a main effect of the PE class topic was found (Model 2 in Table 3). Repeating the regression analyses by changing the reference category of PE class topic indicated that classes had significantly lower collective engagement scores \((M = 1.32 \pm 0.08)\) during racket games compared with other PE activities (ball games: \(M = 1.89 \pm 0.03, \chi^2 = 48.03, df = 1, p < .001\); artistic sports: \(M = 1.87 \pm 0.03, \chi^2 = 45.28, df = 1, p < .001\); fitness training: \(M = 1.86 \pm 0.05, \chi^2 = 32.70, df = 1, p < .001\)). In addition, collective engagement during artistic sports \((\chi^2 = 0.15, df = 1, ns)\) and fitness training \((\chi^2 = 0.19, df = 1, ns)\) were not statistically different from collective engagement during ball games, and no engagement differences occurred between artistic sports and fitness training \((\chi^2 = 0.02, df = 1, ns)\). The random part of the test model indicates that PE class topic explains 7% of the between-class differences. We further explored the interaction between gender distribution and topic of the PE class (see Model 3 in Table 3), which did not result in a significantly ameliorated model \((\chi^2 = 4.33, df = 3, ns)\).

With respect to class size, we found a significant positive association with collective engagement of the class (see Model 4 in Table 3), accounting for 2% of the between-class differences in collective engagement. Finally, in the multiple predictor model (Model 8 in Table 3), all three class-level motivational predictors were significantly associated with collective engagement. Specifically, average autonomous class motivation positively related to engagement of the class, whereas average controlled class motivation and average class amotivation were negatively associated with the engagement of the class. Average class motivation accounts for about 29% of the between-class differences in collective engagement.

**Discussion**

Self-determination theory (Deci & Ryan, 2000) has been increasingly studied in the PE context, as it is considered a sound theoretical framework to investigate motivational regulations that are associated with students’ behaviors and experiences during PE participation (e.g., Cox et al., 2008). The purpose of this study was twofold. First, we examined how much of the observed variation in MVPA and motivation is situated at both the between-student and the between-class level and we inspected the percentage of students meeting the recommended health guidelines for physical activity. Second, we investigated whether between-student and between-class differences in motivation toward PE were related to differences in MVPA and engagement at both levels, after controlling for student- (i.e., gender) and class-level (i.e., gender distribution, class topic, and class size) background variables.
Table 3  Summary of the Model Estimates for the Single-Level Analyses of Collective Engagement Scores

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Model 0</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed Part</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.84 (.02)</td>
<td>1.84 (.02)</td>
<td>1.89 (.03)</td>
<td>1.89 (.03)</td>
<td>1.89 (.03)</td>
<td>1.84 (.03)</td>
</tr>
<tr>
<td>Gender distribution (% boys)\textsuperscript{a}</td>
<td>0.003 (0.001)**</td>
<td>0.001 (0.001)</td>
<td>.001 (.002)</td>
<td>.000 (.002)</td>
<td>.000 (.001)</td>
<td></td>
</tr>
<tr>
<td>Artistic sports\textsuperscript{b}</td>
<td>–0.02 (0.04)</td>
<td>–.01 (.04)</td>
<td>.002 (.04)</td>
<td>.000 (.04)</td>
<td>.000 (.04)</td>
<td></td>
</tr>
<tr>
<td>Fitness training</td>
<td>–0.03 (0.06)</td>
<td>.01 (.06)</td>
<td>–.04 (.06)</td>
<td>–.06 (.05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Racket games</td>
<td>–0.57 (0.08)***</td>
<td>–.32 (.21)</td>
<td>–.37 (.21)</td>
<td>.19 (.18)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent boys \times Artistic sports</td>
<td>.002 (.002)</td>
<td>.002 (.002)</td>
<td>-.004 (.002)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent boys \times Fitness training</td>
<td>-.003 (.003)</td>
<td>.000 (.003)</td>
<td>.001 (.003)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percent boys \times Racket games</td>
<td>.01 (.01)</td>
<td>.02 (.01)</td>
<td>.02 (.01)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class size</td>
<td>.02 (.01)***</td>
<td>.02 (.01)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average autonomous class motivation</td>
<td>.72 (.07)***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average controlled class motivation</td>
<td>–.22 (.09)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average class amotivation</td>
<td>–.22 (.09)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Random Part</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class-level variance</td>
<td>0.25 (0.01)</td>
<td>0.25 (0.01)</td>
<td>0.23 (0.01)</td>
<td>.23 (.01)</td>
<td>.23 (.01)</td>
<td>.16 (.01)</td>
</tr>
<tr>
<td>Deviance test model</td>
<td>994.21</td>
<td>983.94</td>
<td>935.52</td>
<td>931.20</td>
<td>916.97</td>
<td>671.15</td>
</tr>
<tr>
<td>$\chi^2$ (df)</td>
<td>10.27 (1)**</td>
<td>48.42 (3)***</td>
<td>4.33 (3)</td>
<td>14.23 (1)***</td>
<td>245.82 (3)***</td>
<td></td>
</tr>
</tbody>
</table>

*Note. Values in parentheses are standard errors. *p < .05; **p < .01; ***p < .001.

\textsuperscript{a} Gender distribution is expressed as the percentage of boys in a class; \textsuperscript{b} 1 = ball games, 2 = artistic sports, 3 = fitness training, 4 = racket games; reference category = ball games.

Intercept Model 2 represents mean collective engagement score during ball games.
We relied on SDT’s distinction between autonomous and controlled forms of motivation and amotivation and their hypothesized differential relation to behavioral outcomes (Deci & Ryan, 2000). Extending the existing body of work on PE from the SDT perspective, the present research was conducted in a real-life PE setting using objective indicators of MVPA (i.e., accelerometry) and rated collective engagement and made use of multilevel regression analyses to attain the two main purposes of the study.

**Physical Activity Levels and Motivation During Physical Education Class**

Previous studies have demonstrated that adolescents engage in MVPA between 27% and 47% of the effective PE class time (Fairclough & Stratton, 2005). Our results are generally in line with these percentages as students performed MVPA during on average 25% of the effective class time. Yet, only 18.8% of the boys and 7.9% of the girls displayed MVPA scores of 50% or more. These percentages are far short of the US Healthy People 2010 recommendation of performing MVPA during at least 50% of effective PE class time (US Department of Health and Human Service, 2000) and corroborate previous research in primary (e.g., Cardon, Verstraete, De Clercq, & De Bourdeaudhuij, 2004) and secondary (Fairclough & Stratton, 2005) school PE classes indicating that most students do not reach these recommended amounts of MVPA. Further, multilevel analyses with regard to MVPA indicated that between-student and between-class differences constituted, respectively, 37% and 63% of the variance. The observation that between-class variance even outweighs the between-student variance might come as a surprise because one might think that activity levels would vary as a function of students’ personal characteristics. Yet, it appears that students’ individual activity levels during a particular PE class are especially a function of the class to which they belong. This suggests that it is both worthwhile and necessary to examine which factors can explain variation between classes.

With respect to all three motivational variables, we found that the vast majority (i.e., about 90%) of the total variance was situated at the between-student level. With motivational differences between students largely exceeding motivational differences between classes, some might argue that the impact of class- or teacher-based factors is rather limited, hence providing little room for PE teachers to affect students’ motivation through their teaching behavior. However, we prefer a more optimistic interpretation for two reasons. First, we believe it is incorrect to argue that the impact of teaching style can only be observed at the between-class level because teachers might also influence individual students’ motivation through their dyadic interactions and this impact would fail to be noticed at the between-class level. Second, we emphasize that the current measurement of motivation was limited to one single class period. If teachers manage to positively affect students’ motivation each class again (Mouratidis et al., 2011), the impact of PE teachers will be considerable.

**Correlates of Moderate-to-Vigorous Physical Activity and Engagement**

As for the correlates of MVPA at the between-student level, consistent with past work (Bayingana et al., 2006; Fairclough & Stratton, 2005), female adolescents
were significantly less active. Given that girls are more at risk for physical inactivity both in daily life (Bayingana et al., 2006; Sanchez et al., 2007) and during PE (McKenzie et al., 2000), these gender differences are to be taken into account when addressing curricular and motivational issues in PE. Activities need to be provided in which all students, regardless of gender, have similar opportunities to be physically active. However, we should be cautious when interpreting these findings, as the gender differences were qualified by the type of activities offered. Specifically, girls were less active than boys only during ball games and racket games, but not during fitness training and artistic sports. This is in line with previous work showing that boys are more active than girls overall, but specifically during skill drills, game play, and free play (McKenzie et al., 2000). With respect to engagement, the gender distribution within a class played a significant role with classes including a higher percentage of boys being more engaged. Although we did not directly investigate the role of the type of class (i.e., coeducation versus single-sex), this finding can be linked to previous research comparing engagement levels in coeducational classes as opposed to single-sex PE classes (e.g., Lyu & Gill, 2011).

Further, consistent with our hypotheses, the degree of physical activity varied as a function of the topic of the PE course, accounting for 19% of the between-class variance in MVPA. In line with previous research (Fairclough & Stratton, 2005), students were less active during racket games (e.g., badminton), compared with ball games (e.g., basketball), artistic sports (e.g., dance), and fitness training. These findings can be explained in light of the intended primary objectives of these different topics: whereas a badminton lesson perhaps primarily focuses on the development of motor skills, a fitness-oriented PE course, for instance, might rather focus on the promotion of a healthy and active lifestyle, which may result in higher MVPA levels (Chow et al., 2009). The observed reduced MVPA levels during racket games need to be interpreted with caution though, since the use of hip-mounted Actigraph accelerometers limits the assessment of accelerations in the vertical plane, which may result in an underestimation of MVPA levels during PE activities like badminton or table tennis (Riddoch et al., 2004). Future research may register accelerations in the horizontal plane (e.g., arm movements) to obtain a more complete assessment of physical activity levels. Even though accelerometers might underestimate the real MVPA levels during racket games, students were rated to be less engaged during this activity.

With respect to class size, it was interesting to find that no significant association with the MVPA levels of the class was found, hence underlining the relevance of examining other class and teacher characteristics to explain between-class variance in MVPA. On the other hand, classes were found to be significantly more engaged with increasing class size.

Classroom settings including PE classes are usually highly structured and constrained environments where external rules and regulations are typical occurrences and it is difficult for students to self-initiate their physically active behavior. For this reason, one may think that motivational differences have little room to be manifested. Yet, in support of SDT, personal autonomous motivation was positively related to MVPA levels, beyond gender, the topic of the class, and class size. Thus, when students engage in PE for its inherent fun, challenge, or excitement, they are more physically active. Although previous studies (e.g., Cox et al., 2008; Jaakkola et al., 2008; Lonsdale et al. 2009; Yli-Piipari et al., 2009) have reported similar
relations, the relation between autonomous motivation and objectively assessed physical activity levels has hardly been studied in PE-based research.

While past work reported controlled motivation to be negatively associated with self-reported physical activity levels in PE (e.g., Standage et al., 2003), we found no association with objectively assessed MVPA. This null relation is consistent with previous studies in the exercise (e.g., Standage et al., 2008) and sport (e.g., Pelletier, Fortier, Vallerand, & Brière, 2001) domains that assessed participants’ behavior objectively. Theoretically, it has been suggested that controlled forms of motivation can elicit desired behavior, at least in the short term and that its negative behavioral repercussions may manifest only in the long run (Deci & Ryan, 2000). In the context of PE, students may participate in the PE activities, not because they enjoy PE as such, but because the PE teacher threatens to sanction them if they don’t participate (i.e., external pressure) or because they want to prove they are talented youngsters (i.e., internal pressure). Alternatively, the maladaptive correlates of controlled motivation may be less clear in the current study because some students combine autonomous and controlled motives for participation in PE class (Haerens et al., 2010).

As for amotivation, the zero association between amotivation and MVPA levels is inconsistent with previous work (Ntoumanis, 2001; Standage et al., 2005). It is possible that amotivated students just follow their autonomously motivated classmates, despite their own lack of motivation to self-initiate physically active behavior. Perhaps, amotivation would especially relate negatively to physical activity when students are given the free choice during a PE class to exercise or not (Lonsdale et al., 2009).

Extending previous work, the present research investigated whether average class motivation would be associated with class-to-class variation in MVPA and engagement. Aligned with our predictions, the average autonomous class motivation explained substantial variance in MVPA at the between-class level, indicating that classes that are as a whole more autonomously motivated are more physically active. These findings were obtained irrespective of students’ personal motivation, suggesting that students who are controlled motivated or amotivated themselves are more physically active when they find themselves in an autonomously motivated class group. Besides being related to MVPA, average autonomous class motivation was also positively related to engagement. Consequently, when classes are autonomously motivated as a whole compared with other classes, these classes are not only more physically active, they are also more dedicated, enthusiastic, and absorbed in the PE activity.

Parallel to the correlates of personal controlled motivation and personal amotivation, average controlled class motivation and average class amotivation were not related to MVPA. The undesirable correlates of average controlled class motivation and average class amotivation did, however, emerge for collective engagement. Classes that participate in PE because they feel pressured to do so or classes that as a group do not see the point of the PE exercises were not less physically active, but were less engaged during the PE course, as rated by external observers.

The asymmetrical relation of average controlled class motivation and average class amotivation to MVPA and engagement indicates that it is critical to move beyond merely considering MVPA as an outcome. Indeed, classes with controlled or amotivated students might display some degree of behavioral participation during
the PE class, but yet they may pay an emotional price for it, as indexed by lowered engagement. Owing to the well-defined structure of a PE course, students are consistently instructed what to do during a PE class. When a PE teacher requires, for instance, her students to run from point A to point B, students are likely to do what they are told, even though their behavior might be controlled motivated or even amotivated. Yet, they might comply with these instructions without enthusiasm and dedication and just “go through the motions.” Because such lack of engaged participation in the PE class likely fails to foster the development of an active lifestyle, PE teachers would do well to try to promote both MVPA and engagement in their students.

**Limitations and Future Directions**

The present research has some limitations. First, one major limitation was that students were asked to retroactively rate their motivation at the end of the PE course. According to Vallerand’s (1997) hierarchical model of motivation, we assessed students’ motivation at the situational (i.e., with respect to a specific class) rather than at the domain (i.e., PE more generally) level. We did so to examine how much of the variance in situation-specific motivation would differ between students versus between classes and because this guaranteed that motivation and MVPA would be assessed at the same level of generality. Yet, the downside of this choice is that it remains unclear whether domain-specific differences in motivation for PE, which likely have steadily grown through learning experiences and that students “bring” to the PE class, are associated with students’ physical activity during a specific PE class.

Second, given our cross-sectional research design, the observed associations between students’ course-specific motivation and course-specific MVPA might be interpreted in both ways. That is, high levels of physical activity during the past PE course may have increased students’ autonomous motives for participating just as much as their autonomous motivation may have led them to become more physically active. Future research using longitudinal or experimental designs is needed to examine the causal and long-term effects of autonomous motivation on physical activity and engagement during PE class.

Third, the assessment of students’ MVPA levels was restricted to one single PE class. Although, the purpose of the current study was not to estimate the average physical activity in a typical (i.e., representative) PE class in Flanders, a next research step could be to assess students’ physical activity levels across multiple PE classes.

Fourth, because engagement was only assessed as a class-level variable, future studies may assess students’ personal engagement to examine whether personal motivation would relate this outcome.

Fifth, given the substantial portion of variance in MVPA that is situated at the between-class level, future research could identify additional class- and teacher-based factors related to these between-class differences, such as the teaching style of the PE teacher and the motivational environment in the class. In that respect, a different approach to investigate the role of motivational environment could be to include a separate measure to assess the motivational ambience in the class. Specifically, each student could be asked to rate the motivation of his or her class as
a whole separately from his or her personal motivation toward the PE class. This procedure is very similar to research by Papaioannou et al. (2004) and will probably not only increase the likelihood of explaining variance at the class level, but will also enable one to better investigate cross-level interactions between personal motivation and class motivation. For instance, controlled personal motivation might yield a different relation with MVPA and engagement in case one finds oneself in a controlled motivated rather than in an autonomously motivated class.

Conclusions

Motivation toward PE has perhaps primarily been considered as an “individual feature,” thereby neglecting the fact that some classes of students distinguish themselves by their higher and different type of motivation. The present study suggests that it is worth paying attention to class differences in motivation, as classes that are more autonomously motivated as a whole are both more active and more engaged, whereas those classes being pressured into PE activities or feeling amotivated displayed lower enthusiasm and less expenditure of effort. These correlates emerged above and beyond those observed for gender, PE class topic, and personal motivation, adding further support to the growing body of literature documenting the benefits of getting a group of students actively engaged in PE class for autonomous reasons.

Acknowledgments

This research was supported by a research project grant of the Flemish Research Foundation awarded to the second author (Grant G.0234.10).

References


*Manuscript submitted*: June 23, 2011

*Revision accepted*: April 1, 2012
Appendix

Items of the BRPEQ to Assess Students’ Motivation Toward PE Class

I put effort in this PE class . . .

Autonomous Motivation

Intrinsic motivation
. . . because I enjoy this PE class
. . . because I find this PE class a pleasurable activity
. . . because this PE class is fun
. . . because I get pleasure and satisfaction from participating in this PE class

Identified regulation
. . . because I find this PE class personally meaningful
. . . because I fully recognize the usefulness of this PE class
. . . because this PE class is personally important to me
. . . because I value the benefits of this PE class

Controlled Motivation

Introjected regulation
. . . because I have to prove myself
. . . because it is the only way to be proud of myself
. . . because I would feel like a failure if I didn’t
. . . because I would feel guilty if I didn’t

External regulation
. . . because I otherwise get criticized
. . . because others will appreciate me less
. . . because it is the only way to please others
. . . because I felt the pressure of others to participate in this PE class

Amotivation

I don’t see why this PE class is part of the curriculum
I don’t see why I should bother participating in this PE class
I don’t see the point of this PE class
I think this PE class is actually a waste of time