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Research article

A Multilevel Latent Growth Modelling of the Longitudinal Changes in Motivation Regulations in Physical Education

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Abstract

The purpose of this study was to examine individual- and classroom-level differences in the longitudinal change in motivational regulations during physical education students' transition from elementary (Grade 6) across middle school (Grades 7 to 9). A sample of 757 Finnish adolescents ($M = 12.71$, $SD = 0.23$) participated in this study. Participants of the study responded to questionnaires collected six times. A multilevel latent growth modelling approach was used to analyze the data. Results showed that motivational regulations in physical education developed at different rates during middle school. More specifically, students': (a) identified regulation increased across Grades 6 to 9; (b) amotivation increased during middle school transition from Grade 6 to 7; and (c) introjected regulation declined from Grade 8 to 9. Other motivational regulations remained stable across time. The changes in amotivation and introjected regulation were largely due to individual factors, whereas the changes in identified regulation were due to environmental factors.

Key words: Self-determination theory, intrinsic motivation, extrinsic motivation, multilevel latent growth modeling.

Introduction

Physical inactivity is one of the most important reasons for increased obesity worldwide (Finucane et al., 2011). Although physical inactive lifestyle induces a serious health threat to individuals (Warburton et al., 2006) and it has shown to place a staggering cost on global economy (Finkelstein et al., 2009), young people in many developed countries are less physically active and more overweight and obese than before (Currie et al., 2008). To address the obesity epidemic, scholars and institutions have advocated schools and evidence-based school physical education (PE) programs to promote public health (Institute of Medicine; 2012; Sallis et al., 2012). School PE can introduce students to a wide range of meaningful sport and exercise activities and, in doing so, enhance their motivation and facilitate their life-long physical activity (PA) participation. However, evidence exist that adolescents' motivation towards PE declines across middle school years (Ntoumanis et al., 2009) and this trend parallels with age-related declines in PA participation (Currie et al., 2008). Such decreases are problematic, given that positive experiences in school PE have been shown to be related to leisure-time PA participation (Hagger et al., 2005). Thus, grounded in self-determination theory (SDT; Deci and Ryan, 1985), the

purpose of the current study was to examine the longitudinal change in the motivational regulations among PE students across Finnish comprehensive school grades 6 to 9.

The study theoretical framework is based on the SDT, which is a macro-theory consisting of five mini theories to understand and explain complex interaction among social environment, motivation and behavior (Deci and Ryan, 1985; 2000). One of the key concepts of the SDT is perceived locus of causality (PLOC) that reflects individual's quality of motivation toward specific behavior in a specific context (Ryan and Connell, 1989). PLOC describes a person's perception of whether the origin of their reasons for engaging in a behavior is internal (done willingly and out of free choice) or external (done because they are compelled or required to do so, either by external pressure from others or because of self-imposed pressures).

According to the SDT, motivational regulations exist as a continuum ranging from amotivation through four different types of extrinsic regulations (external regulation, introjected regulation, identified regulation and integrated regulation) to intrinsic motivation (Deci and Ryan, 2000; Deci et al., 2013). The theory suggests that the level of internalization, or autonomy, increases towards the intrinsic motivation end of the continuum (Deci and Ryan, 2000; Deci et al., 2013). Intrinsic motivation represents the most internalized regulation, and it refers to engaging in an activity because of the pleasure and satisfaction derived from participation (Deci and Ryan, 2000). Integrated regulation is the most internalized form of extrinsic regulation. It involves the identification of the importance of behaviors, but also integrates those identifications with other aspects of the self. Integrated regulations exist when people have fully accepted the identified behaviors by bringing them into harmony or coherence with other aspects of their goals and values (Deci and Ryan, 2000). Identified regulation is the next regulation towards intrinsic motivation end in the continuum and it occurs when the individual has recognized and accepted the underlying behavior of values or goals (Deci and Ryan, 2000). Introjected regulation is a form extrinsic regulation, which is influenced by esteem-based pressures to act, such as avoidance of guilt and shame or concerns about self- and other approval (Deci and Ryan, 2000). External regulation represents the purest form of extrinsic motivation, and it is occurring if an activity is done because of external factors like rewards, constraints or fear

of punishments (Deci and Ryan, 2000). Finally, amotivation is defined as a state in which people lack the intention to behave and thus lack motivation (Deci and Ryan, 2000). Amotivated individuals typically perceive feelings of incompetence, expectancies of uncontrollability and perform activities without purpose.

SDT suggests that more internalized forms of regulations are related to adaptive cognitive, affective and behavioral responses, whereas less internalized forms of regulations correlate with maladaptive consequences (Deci and Ryan, 2000). Research has supported these premises indicating that internalized regulations (intrinsic motivation and identified regulation) in PE positively correlate with adolescents' PA engagement in PE (Jaakkola et al., 2008; Lonsdale et al., 2009), leisure-time PA (Chatzisarantis and Hagger, 2009), and intention to be physically active in leisure-time (Hagger et al., 2003; Ntoumanis, 2001; Standage et al., 2003). In contrast, in the same studies external regulations (amotivation, external and introjected regulation) have typically been shown to have zero correlation or associate negatively with PA outcomes.

Organismic integration theory (OIT) is one of the mini theories within SDT. According to OIT, internalization is "*an active, natural process in which individuals attempt to transform socially sanctioned mores or requests into personally endorsed values and self-regulations*" (Deci and Ryan, 2000, 235-236). Through internalization people actively attempt to transform an extrinsic motive into personally endorsed values and, thus, assimilate with behavioral regulations that were originally external (Ryan, 1995). Deci and Ryan (2000) also suggested that internalization has natural developmental tendency. The central tenet of the OIT is that social context can enhance or forestall internalization of motivational regulations (Deci and Ryan, 2000). Internalization will happen if psychological environment of an individual satisfies one's psychological needs to be autonomous, competent and to feel relatedness (Deci and Ryan, 2000). Research has shown that in conditions where needs are satisfied, previously external regulation of behaviours have changed to more internal forms of regulations. These findings have been found especially in the context of education (e.g., Grolnick et al., 1991; Williams and Deci, 1996). Although the process of internalization plays an important role in SDT, there is yet to be conclusive empirical evidence on how regulations of behavior change over time.

To our knowledge only two previous studies have specifically examined the changes in students' motivational regulations. Digelidis and Papaioannou (1999) found in a study on Greek students ($n = 674$) that senior high school students had lower intrinsic motivation than middle school and elementary school students. This study, however, was not longitudinal but comparing three cross-sectional samples. Recently, utilizing a sophisticated multilevel regression analysis strategy, Ntoumanis et al. (2009) investigated a change in 13 to 15 years old Greek students' motivational regulations ($n = 453$) across three middle school years. Testing linear, quadratic, and cubic growth trajectories, they found that levels of intrinsic

motivation and identified regulation decreased linearly over time. Subsequently, amotivation increased linearly across middle school years, whereas other forms of regulation remained stable.

Although Ntoumanis et al. (2009) examined the change in motivational regulations in PE across middle school years, the study did not address the middle school transition, during which the deepest declines in student motivation towards different school subjects have been reported (Eccles et al., 1989; Wigfield et al., 1991; 2006). Furthermore, by utilizing advanced statistical methodologies this study was able to examine, not only the individual change in student motivational regulations, but the classroom effect. Specifically, this study applied a multilevel latent growth modelling (multilevel LGM) in which a) the shape of each student's individual growth trajectory was estimated; b) the inter-individual change was examined (the examination on whether a growth trajectory between individuals differ across time); and c) the differences of students within each class was compared to students in other classes. The multilevel LGM approach is highly important because it allows an examination whether changes in students' motivational regulations in PE are due to individual reasons or due to the classroom membership. This study addressed these shortcomings and, thus, provided advanced examination on the change of adolescents' PE motivation.

The aim of the study was to examine changes in adolescents' motivational regulations towards PE during middle school transition from elementary school (Grade 6) across middle school (Grades 7 to 9). A multilevel LGM approach was used that estimates the initial levels of the change trajectories of the studied variables (Intercept) and a linear, quadratic, and cubic growth over time in these trajectories (Slope, Quadratic, and Cubic factors) and separately considers average levels in these trajectories estimated on the full sample from the inter-individual variability around these average levels (Duncan et al., 1999). In addition, multilevel LGM approach acknowledges the possible hierarchy of the data by estimating individual-level (within-subject) and between-level (between-subject) covariance matrixes. Based on the previous evidence (Ntoumanis et al., 2009), we hypothesized adolescents' intrinsic motivation and identified regulation to decrease, identified, introjected, and external regulations to be stable, and amotivation to increase across time. In addition, based on the study findings in the area of academic motivation and sports we expected the most marked changes in students' motivational regulations in PE to occur during the middle school transition (Eccles et al., 1989; Wigfield et al., 1991).

Methods

Participants and procedure

The study sample comprising 757 adolescents [356 girls, 401 boys; 12 to 13 years old ($M = 12.31$, $SD = 0.22$) at the beginning of the study] from one midsized town, enrolled in 17 elementary and eight urban middle schools, were followed from Grade 6 to 9. Before the initiation of the study, the research protocol was approved by the ethical

committee of the local university. In addition, parental consents and students assents were obtained prior data collection. First, out of the total 663 invited 6th grade students 597 volunteered to participate in the study. During the study, 17 students moved away from the school district, thus, their data were omitted from the final data set. Second, in the beginning of the Grade 7 additional 512 students were invited to participate in the study. Out of 512 invited students, 232 students provided necessary documents and volunteered to participate. Thus, the original sample consisted of 812 adolescents (392 girls, 420 boys; $M = 12.31$, $SD = 0.22$). The participants' responded to questionnaires six times: April 2007 at Grade 6 (Time 0, $n = 580$), October 2007 at Grade 7 (Time 1, $n = 801$), April 2008 at Grade 7 (Time 2, $n = 801$), October 2008 at Grade 8 (Time 3 $n = 792$), April 2009 at Grade 8 (Time 4, $n = 801$), and October 2009 at Grade 9 (Time 5, $n = 766$). After data collection, one special education middle school was omitted from the study. This school had a special PE curriculum with special teaching arrangement and it did not represent a traditional Finnish middle school. Thus, the final data comprised aforementioned 757 students.

Measures

The sport motivation scale: The contextual intrinsic, extrinsic, and amotivation were assessed using the Finnish version of the Sport Motivation Scale (SMS) (Pelletier et al., 1995). The SMS consisted of seven subscales, comprising three types of intrinsic motivation (intrinsic motivation to accomplish things, intrinsic motivation to know and intrinsic motivation to experience stimulation), three forms of extrinsic motivation (identified, introjected, and external regulation), and amotivation. Each dimension consisted of four items which were rated on a five-point Likert scale (1 = *does not correspond at all* ... 5 = *correspond exactly*). All 28 items of the SMS were used and each incorporated the individual item stem of "Why I'm currently participating in physical education?", which reflects an overall or more generalized perception of PE. Subscale scores were calculated for amotivation, external regulation, introjected regulation, identified regulation, and intrinsic motivation. Previous studies have indicated that the Finnish version of SMS demonstrated satisfactory reliability and construct validity in studies including cohorts of 12 years old and 15 year-old students' within PE context (e.g., Jaakkola et al., 2008; Kalaja et al., 2009). It should be recognized that the Sport Motivation Scale-2, which is the revised version of original SMS, has been published 2013 (Pelletier et al., 2013). However, we were not able to utilize it because it was published after we implemented last phase of our data collection.

Data analysis

The descriptive statistics of the students' motivational regulations across time were tabulated. Our preliminary analyses showed that missing data were missing at random, and thus the EM-type missing data procedures of the EQS 6.2 software were utilized (Bentler and Wu, 1998). By following the protocol of Muthén (1994), first, conventional confirmatory factor analyses of the total covariance structure (one level LGMs) for each motivational dimension were determined. Linear, quadratic, and cubic curves were fitted to the data to determine the best fit. Second, intraclass correlation coefficients (ICC) were estimated to determine the amount of total variance explained by the individual-level (within-subject) and class-level (between-subject) covariance. Third, the pooled within-sample covariance matrix provided in the EQS 6.2 in the analysis of the ICCs was used to estimate the within structure. This provides an estimation of individual-level parameters (within-subject). As this estimate is not distorted by the between covariation, it provides a better model fit compared to total covariance matrix. Finally, an estimation of between-structure was included in the individual-level analysis. After obtaining the pooled within- and between-sample covariance matrices, we conducted the Limited Information Multilevel LGM was fitted for the five motivational regulations.

All analyses were conducted using EQS for Windows 6.2 (Bentler and Wu, 1998). The following fit indices provided by EQS were used to examine the adequacy of the models: chi-square statistic, the normed fit index (NFI), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA) and its confidence intervals. For NFI and CFI, values close to .95 are taken to reflect acceptable fit (Hu and Bentler, 1999). The RMSEA is based on the analysis of residuals and compensates for the effects of model complexity. For this index, values of close to .10 are taken to indicate acceptable fit (MacCallum, Browne and Sugawara, 1996). An ICC close to zero indicates that classroom membership has no or only minimal effect on the total variance. Coefficients of .05, .10, and .15 are to be considered as small, medium, and large values (Hox, 2002). Even small values warrant the use of multilevel LCMs an analysis strategy.

Results

Descriptive statistics

The means and standard deviations of the repeated measures of the motivational regulations are shown in Table 1. On average, Finnish students were relatively motivated in PE. Intrinsic motivation ranged from 3.11 to 3.24, external regulations ranged from 2.60 to 3.46, and amotivation ranged from 1.85 to 2.43.

Table 1. Descriptive statistics for the repeated measures of motivational regulations. Data are means (\pm SD).

	Year 6 (S)	Year 7 (F)	Year 7 (S)	Year 8 (F)	Year 8 (S)	Year 9 (F)
Intrinsic Motivation	3.11 (.65)	3.23 (.77)	3.14 (.73)	3.17 (.72)	3.20 (.69)	3.24 (.65)
Identified Regulation	2.90 (.66)	3.02 (.81)	3.05 (.77)	2.97 (.77)	3.04 (.75)	3.09 (.71)
Introjected Regulation	3.31 (.69)	3.26 (.84)	3.24 (.72)	3.29 (.72)	3.29 (.74)	2.51 (.53)
External Regulation	2.60 (.73)	2.73 (.78)	2.82 (.75)	2.78 (.78)	2.89 (.75)	2.88 (.72)
Amotivation	1.85 (.69)	2.15 (.85)	2.43 (.84)	2.25 (.84)	2.36 (.85)	2.36 (.88)

Table 2. Confirmatory factor analysis of total covariance structure.

	Growth Curve	χ^2	df	p	NFI	CFI	RMSEA	90% of CI
Intrinsic Motivation	Linear	149.28	16	.00	.864	.874	.115	.098, .133
	Quadratic	100.21	12	.00	.915	.923	.104	.084, .125
	Cubic	39.98	7	.00	.973	.978	.075	.049, .105
Identified Regulation	Linear	103.86	16	.00	.919	.930	.085	.070, .101
	Quadratic	35.75	12	.00	.988	.997	.021	.000, .049
	Cubic	14.35	7	.04	.994	.999	.018	.000, .056
Introjected Regulation	Linear	1013.77	16	.00	.779	.785	.194	.177, .212
	Quadratic	384.11	12	.00	.946	.951	.107	.087, .127
	Cubic	199.29	7	.00	.978	.981	.088	.062, .117
External Regulation	Linear	98.51	16	.00	.964	.970	.079	.061, .097
	Quadratic	64.81	12	.00	.975	.979	.075	.055, .097
	Cubic	47.84	7	.00	.983	.986	.084	.058, .113
Amotivation	Linear	296.38	16	.00	.922	.930	.105	.088, .123
	Quadratic	138.43	12	.00	.957	.963	.089	.069, .110
	Cubic	90.13	7	.00	.967	.970	.108	.082, .136

Table 2 shows the general trends of the growth trajectories of the five regulations. We compared linear, quadratic, and cubic curves. A statistically significant linear trajectory reflects a constant change (either increasing or decreasing) across time. A negative quadratic trend implies the rate of change of a trajectory that peaks, and then decline over the year-year period whereas the trend of a positive quadratic change is opposite. Finally, a positive cubic trajectory reflects a change in which a trajectory tends to peak first, then plateau, and finally increase over the year to year period. The fit indices of the estimated models indicated that the most suitable representation of the individual-level change (when ignoring the classroom effect) can be retrieved from cubic trajectories (intrinsic, identified, introjected, and external). For amotivation a negative quadratic trend best described the growth trajectory.

ICCs are presented in Table 3. ICCs reflect the proportion of the total variance that is explained by the individual differences and the differences between classes. All the ICCs ranged from 0.01 to 0.07, indicating that there were between-class variations with a small to medium effects. In other words, a large ICC indicated that a small to medium proportion of variation in motivational regulations is due to classroom membership. Since there were some levels of between-class variation, it was reasonable to proceed and estimate a multilevel LGM model in which both individual and between classes differences are estimated.

Finally, a Limited Information Multilevel LGM model was fitted for the five motivational regulations using the within-structure covariances and between-structure covariances simultaneously. Thus, the change of motivational regulations were estimated accounting for both individual and classroom variation. Table 4 presents the fit indices and parameter estimates. The study showed students' intrinsic motivation (intercept = 2.21, slope =

0.07, quadratic = -0.04, cubic = 0.01) along with identified (intercept = .68, slope = 1.85, quadratic = -0.66, cubic = .07) and external regulation (intercept = 1.83, slope = 0.10, quadratic = -0.02, cubic = 0.00) to increase following a cubic curve trajectory. Although the cubic growth trajectory best described the development of intrinsic motivation and extrinsic motivation, the growth indicators (slope, quadratic, and cubic pieces) were not statistically significant. This suggested that the development of intrinsic motivation and extrinsic regulation were stable across time. The cubic curve for identified regulation was statistically significant and followed the trajectory; an increase during transition from elementary school to middle school, relatively stable levels across middle school, and increasing levels during end of the middle school. The change in students' introjected regulation, on the contrary, was negative following a cubic trajectory (intercept = 2.33, slope = -0.19, quadratic = 0.14, cubic = -0.03). The slope of the introjected regulation was not statistically significant, indicating stability across elementary and middle school years six and seven. However, the study showed declining levels of introjected regulation during last two measurement points. Finally, in amotivation, a negative quadratic trend best described the growth trajectory; amotivation increasing during the transition from elementary school to middle school, but declining across middle school years (intercept = 0.60, slope = 0.51, quadratic = -0.73).

The individual-level variance (intercept = 0.16, slope = 0.42, quadratic = 0.09, cubic = 0.01) showed that there were individual variation in the initial levels and growth of intrinsic. Between-level analyses showed that students' intrinsic motivation did not vary between different classes (intercept = 0.14, slope = 0.12, quadratic = 0.02, cubic = 0.00). In identified and extrinsic regulation only the individual-level variance of the intercept was statistically significant (identified regulation - within-

Table 3. Intraclass correlations for the repeated measures.

	Year 6 (S)	Year 7 (F)	Year 7 (S)	Year 8 (F)	Year 8 (S)	Year 9 (F)
Intrinsic Motivation	.06	.01	.05	.05	.06	.04
Identified Regulation	.04	.01	.01	.02	.02	.02
Introjected Regulation	.06	.07	.00	.02	.02	.07
External Regulation	.06	.05	.04	.06	.04	.04
Amotivation	.05	.03	.06	.04	.06	.07

Table 4. Fit indices and parameter estimates from the limited information multilevel latent growth models.

Coefficient	Between-level		Within-level		Fit Indices	
	Effect	t value	Effect	t value		
Intrinsic Motivation	Means					
	Intercept		2.21	25.04	$\chi^2 = 86.05$ df = 17	
	Slope		.07	.49	p < .01	
	Quadratic		-.04	-.52	NFI = .920	
	Cubic		.01	.56	CFI = .926	
	Variances					
	Intercept	.14	.78	.16	2.67	RMSEA = .146
	Slope	.12	.35	.42	3.43	90% CI = (.118, .174)
	Quadratic	.02	.32	.09	4.02	
	Cubic	.00	.23	.01	4.11	
Identified Regulation	Means					
	Intercept		.68	7.36	$\chi^2 = 35.23$ df = 17	
	Slope		1.85	13.48	p < .01	
	Quadratic		-.66	9.97	NFI = .984	
	Cubic		.07	8.18	CFI = .992	
	Variances					
	Intercept	.16	.71	.15	2.27	RMSEA = .049
	Slope	.06	.16	.08	.68	90% CI = (.010, .083)
	Quadratic	.00	.00	.01	.52	
	Cubic	.00	.02	.00	.03	
Introjected Regulation	Means					
	Intercept		2.33	24.98	$\chi^2 = 59.33$ df = 17	
	Slope		-.19	1.76	p < .01	
	Quadratic		.14	2.67	NFI = .968	
	Cubic		-.03	3.65	CFI = .973	
	Variances					
	Intercept	.15	.79	.48	7.01	RMSEA = .108
	Slope	.00	.00	.29	2.81	90% CI = (.080, .137)
	Quadratic	.01	.14	.02	.95	
	Cubic	.00	.24	.00	.06	
External Regulation	Means					
	Intercept		1.83	19.06	$\chi^2 = 51.47$ df = 17	
	Slope		.10	.83	p < .01	
	Quadratic		-.02	.40	NFI = .973	
	Cubic		.00	.33	CFI = .977	
	Variances					
	Intercept	.16	.96	.26	4.34	RMSEA = .107
	Slope	.16	.60	.00	.00	90% CI = (.080, .137)
	Quadratic	.03	.52	.02	.99	
	Cubic	.00	.00	.01	1.01	
Amotivation	Means					
	Intercept		.60	6.82	$\chi^2 = 67.07$ df = 26	
	Slope		.51	7.44	p < .01	
	Quadratic		-.73	53.05	NFI = .960	
	Variances					
	Intercept	.11	1.02	.43	11.67	CFI = .971
Slope	.06	1.00	.12	6.26	RMSEA = .079	
Quadratic	.01	1.00	.09	4.52	90% CI = (.059, .101)	

subject: intercept = 0.15, slope = 0.08, quadratic = 0.01, cubic = 0.00; between-subject: intercept = 0.16, slope = 0.06, quadratic = 0.00, cubic = 0.00) (extrinsic regulation - within-subject: intercept = 0.26, slope = 0.00, quadratic = 0.02, cubic = 0.01; between-subject: intercept = 0.16, slope = 0.16, quadratic = 0.03, cubic = 0.00). This showed that although at Grade 6 there were individual differences in the identified and extrinsic regulation, the change across time was similar between different students. The study also showed that in introjected regulation there were individual-level variance in intercept and slope components (within-subject: intercept = 0.48, slope = 0.29, quadratic = 0.02, cubic = 0.00; between-subject: intercept = 0.15, slope = 0.00, quadratic = 0.01, cubic = 0.00),

indicating individual level differences both in the initial level and change across time. Finally, while there were individual-level variation in the intercept and slope in students' amotivation (intercept = 0.43, slope = 0.12, quadratic = 0.09), there were no statistically significant between-level variation (intercept = 0.11, slope = 0.06, quadratic = 0.01). These findings indicated that student initial level and change varied but there were no differences between classes.

Discussion

The purpose of the current study was to examine the development of adolescents' motivational regulations in PE

across Grades 6 to 9. This study was to address shortcomings of the previous studies in examining the changes in adolescents' PE motivation during the developmental period when school students' intrinsic motivation, not only towards PE, but also towards academic school subjects have been reported to decline (see review by Wigfield et al., 2006). In addition, given the positive relationship between PE motivation and PA participation (Hagger et al., 2005), and that PA has been shown to be positively linked to physical and psychological health benefits (Strong et al., 2005), it is highly important to comprehend the changes that adolescents experience in their PE motivation.

The results of the study showed that Finnish middle school students were motivated in school PE. In addition, students' quality of motivation varied students participating in mandatory PE due to both intrinsic and extrinsic reasons. Although the individual level (within-subject) results of the study showed that a cubic trajectory (changing trend, then plateauing trend, and finally changing trend again) best described the change in all motivational regulations but amotivation (best described by a quadratic trajectory), the class-level results (between-subject) showed that only the changes in identified and introjected regulation along with amotivation were statistically significant.

The study showed that students' intrinsic motivation stayed at relatively high level through Grades 6 to 9. This finding contradicts with our hypothesis and previous studies that have shown intrinsic motivation to decline across middle school years (Ntoumanis et al., 2009). The findings of our study showed that there were moderate individual effects on students' intercept, slope, quadratic, and cubic growth indicators. In other words, students had different levels of intrinsic motivation at Grade 6 and although their cubic change trajectory was not statistically significant, students' intrinsic motivation developed at different rates. Interestingly, the between-level analysis showed that there was no statistically significant classroom effect on students' intrinsic motivation. Taken together, these findings on the change of intrinsic motivation suggest that students are differently motivated in PE at the end of elementary school and the changes are relatively stable across time. The minor changes in the growth component variances indicated that the fluctuation in the change trajectories were due to individual effect and not due classroom effect. These findings indicate that: (a) teachers across different middle schools are providing equal motivational experiences in terms of intrinsic motivation or (b) the formation of intrinsic motivation is mostly individual that cannot be influenced by the teacher. Previous studies have shown that students' intrinsic motivation can be manipulated by autonomy-supportive teaching strategies (Hagger and Chatzisarantis, 2012). In addition, cross-cultural comparisons have shown that Finnish PE students report higher perceptions of teacher autonomy-support compared to their peers in Great Britain, France and Hungary (Hagger et al., 2009). Therefore, it is possible that students' constantly high levels of intrinsic motivation in PE are due to Finnish PE teacher autonomy-supportive teaching practices. A trend in identified regula-

tion followed a positive cubic trajectory, in which students' identified regulation increased across middle school transition from Grade 6 to 7, then declined during Grades 7 to 8, and finally increased during the last years of elementary school. In addition, the individual- and between-level variances showed moderate differences in students' identified regulation at Grade 6 but no differences in the change components occurred. In other words, the positive changes in identified regulation were demonstrated in similar fashion across student population and the changes were not due to differences between students or classes. This finding contradicts with previous studies that have shown identified regulation to decline across middle school years (Ntoumanis et al., 2009). It is noticeable that in the Finnish school system, elementary school PE is taught by general teachers, whereas middle school PE is taught by a specialist PE teacher. It is possible that the specialist PE teachers compared to general teachers can better support students' needs to be autonomous, competent and to feel social relatedness, and help students to understand the value of PE in their everyday life (Constantinides, 2007). However, SDT postulates that identified regulation is a form of extrinsic regulation, in which an individual has identified the values of activity (in this case PE), but participation is yet to be internalized to be fully intrinsic. The increase in identified motivation without statistically significant change in intrinsic motivation indicates that the process of internalization in Finnish PE students' may not occurring during middle school years.

This study found that students' introjected regulation declined during the middle school transition, increasing slightly during middle school and declining again during Grades 8 to 9. Although there was a moderate variance in the Grade 6 levels and slope component in students' introjected regulation, there was no variation in other growth components or between PE classes. Deci and Ryan (2000) have operationalized introjected regulation as a regulation where an individual perceive behavior as externally regulated coming from external sources such as concerns about others' approval. The findings of this study suggest that these social constraints become less important to the students in regards of the Finnish students' engagement in PE. This is a highly interesting finding considering that previous studies have highlighted the importance of school peers in different contexts of adolescents' life (Fulgini and Eccles, 1993). Similar findings have also been found studies conducted in Finnish PE and PA context (Yli-Piipari et al., 2011). The study of Yli-Piipari et al. (2011) showed that if peers valued PE, it related to their overall PA levels one year later. However, it is possible that when students get older and are with the same teacher and classmates longer, they are less concerned about the approval of others compared to earlier grade levels where they are just getting to know the teacher and peers. Alternatively, it may be that Grade 9 students are less concerned about the opinions around them. The non-significant variance during this declining period supports this conclusion showing that the decline is evident across the sample and it cannot be contributed to individual differences between students.

Although this study showed that students' extrinsic

motivation developed following a positive cubic trend, the change was marginal and not statistically significant. The examination of within- and between-level variances indicated that although students differed in their extrinsic regulation at Grade 6, there were no developmental or class level differences. This finding supports the findings of Ntoumanis et al. (2009) that have showed extrinsic regulation to be stable across Greek middle school. SDT argues that extrinsically regulated individuals are participating in activity due external contingencies of reward or punishment (Deci and Ryan, 2000). When people perceive their environment controlled, they experience pressure to think, feel, or behave in particular ways. Although previous studies have shown Finnish PE students perceive their classroom climate less-controlling and more autonomy-supportive compared to their counterparts in the United States (Yli-Piipari, 2014), scholars have acknowledged the controlling nature of institutionalized schooling (Sun and Chen, 2010). Although school administrators, teachers, and regulations may increase students' perception of control, the stable development and non-significant variation of external regulations indicate that students do not perceive this occurring during last grades of Finnish elementary school.

Finally, the study showed that students' amotivation increased when students entered a middle school level, whereas their amotivation declined across the rest of middle school. This is an interesting finding that conflicts with the findings of Ntoumanis et al. (2009) that have shown amotivation to increase across middle school grades. Amotivation in PE may arise from different sources (Shen et al., 2010). It may be that amotivated individuals cannot perceive a relationship between their actions and subsequent outcomes of those actions (Pelletier et al., 2001). They may feel lacking causality and control of their actions and will thus invest little effort or energy in accomplishment of the actions (Ntoumanis et al., 2004). Alternatively, it has been suggested that insufficient academic values towards school subjects may lead to amotivation (Wigfield and Eccles, 2000). If students perceive their environment emphasizing negative values towards school it is most likely that students lack motivation towards all school subjects. However, non-significant class-level variance does not support this conclusion indicating that the demonstrated increase during middle school transition is due to individual reason than class membership, in other words the influence of PE teacher or peers.

The findings of this study did not demonstrate the process of "internalization" (Deci and Ryan, 2000) occurring during middle school. According to OIT, internalization take place if psychological environment satisfies one's psychological needs to be autonomous, competent and to feel relatedness (Deci and Ryan, 2000). This study showed that students were intrinsically motivated, which implies that psychological environment of school PE was need supportive. However, the findings do not show that students' motivation pattern transferred from extrinsic regulations to intrinsic. It might be so that PE once a week is not enough to facilitate the process internalization, and transform originally extrinsic motives into personally

endorsed values.

Some limitations of the study require further scrutinizing. First, only 580 adolescents responded the questionnaires at Grade 6 (T0). These adolescents' arrived from different school districts and, thus, they were not available during elementary school data collection. Although careful missing value analyses did not find any statistically significant differences between this subsample and target sample, it is possible that the subsample differed from the target sample at Grade 6. Second, although we found that a cubic trajectory was the best representation of the growth in all motivational regulations (the change in amotivation was quadratic), only the changes in identified (slope, quadratic, and cubic parts), introjected (cubic part), and amotivation were statistically significant. Based on the findings of this study, we suggest future research to investigate the change of motivational regulations over longer time period. For example, when students are in high school their regulations towards PA contexts may change because they are more capable to understand physical, psychological, and social importance of PA for themselves. Additionally, in future it would be interesting to analyse how students internalize regulations over time and during school transitions.

Conclusion

The results of this study showed that quality of motivation, that is motivational regulations in PE, developed differently during last three years of comprehensive school. Although most of the regulations were stable across Grades 6 to 9, students' identified regulation increased. Whereas middle school transition accelerated the increase in identified regulation, it increased also student amotivation towards PE. The variance in the growth trajectories, however, indicates that identified regulation and amotivation may arise from the different sources. The study shows that the changes in adolescents' identified regulation were not because of the class variation or individual effect; therefore it may be that the exposure of new specialist PE teachers, contrary to general teachers at elementary school level, may have an overall positive effect on students' value structure across different classrooms. On the contrary, the study showed that the increase in amotivation was due to individual reasons. It may be that in a long term some adolescents get eliminated from goals and objectives of PE, but the study showed that changes in school, class, or PE teachers have no impact on this development. Finally, introjected regulation declined during last grades, suggesting that the effect of social determinants becomes less important in regards of the PE participation. The findings of this study provide information on the development of PE motivation across middle school years with some practical implications to the practitioners. The study showed that students have very individualized motivational profiles in PE. This finding suggests that PE teachers should differentiate teaching as much as possible, and the use versatile teaching methods to fulfil different students' needs autonomy, competence, and relatedness through school years. Future studies are needed to examine whether these changes are

due to diminishing influence of parents or peers or may due to increases in identified regulation.

References

- Bentler, P.M. and Wu, E. (1998) *EQS for Windows* (Version 5.7). Encino, CA, Multivariate Software.
- Chatzisarantis, N.L. and Hagger, M.S. (2009) Effects of an intervention based on self-determination theory on self-reported leisure-time physical activity participation. *Psychology and Health* **24**, 29-48.
- Constantinides, P. (2007) *Comparison of teaching processes in elementary physical education classes taught by specialists and non-specialists*. Doctoral dissertation, Teachers College, Columbia University. Available from URL: <http://proquest.umi.com/pqdlink?Ver=1&Exp=12-18-2015&FMT=7&DID=1379567351&RQ T=309&attempt=1>
- Currie, C., Gabhainn, S.N., Godeau, E., Roberts, C., Smith, R., Currie, R., Pickett, W., Richter, M., Morgan, A. and Barnekow, V. (2008) *Inequalities in young people's health. Health behaviour in school-aged children. International report from the 2005/2006 survey*. WHO Europe. Health policy for children and adolescents no. 5. Available from URL: <http://www.euro.who.int/en/health-topics/noncommunicable-diseases/obesity/publications/pre-2009/inequalities-in-young-peoples-health.-hbsc-international-report-from-the-20052006-survey>
- Deci, E.L. and Ryan, R.M. (1985) *Intrinsic motivation and self-determination in human behaviour*. Plenum Press, New York, NY.
- Deci, E.L. and Ryan, R.M. (2000) The "what" and "why" of goal pursuits: Human needs and the self-determination of behaviour. *Psychological Inquiry* **11**, 227-268.
- Deci, E.L., Ryan, R.M. and Guay, F. (2013) Self-determination theory and actualization of human potential. In: *Theory driving research: New wave perspectives on self-processes and human development*. Eds: McInerney, D., Marsh, H., Craven, R. and Guay F. Charlotte, NC: Information Age Press. 109-133
- Digelididis, N., and Papaioannou, A. (1999) Age-group differences in intrinsic motivation, goal orientations and perceptions of athletic competence, physical appearance and motivational climate in Greek physical education. *Scandinavian Journal of Medicine and Science in Sports* **9**, 375-380.
- Duncan, T.E., Duncan, S.C., Strycker, L.A., Li, F. and Alpert, A. (1999) *An introduction to latent variable growth curve modelling: Concepts, issues, and applications*. Lawrence Erlbaum Associates, Mahwah, NJ.
- Eccles, J.S., Wigfield, A., Flanagan, C., Miller, C., Reuman, D. and Yee, D. (1989) Self-concepts, domain values, and self-esteem: Relations and changes at early adolescence. *Journal of Personality* **57**, 283-310.
- Finkelstein, E.A., Trogon, J.G., Cohen, J.W. and Dietz, W. (2009) Annual medical spending attributable to obesity: payer- and service-specific estimates. *Health affairs*, **28**, 822-831.
- Finucane, M.M., Stevens, G.A., Cowan, M.J., Danaei, G., Lin, J.K., Paciorek, C.J., Singh, G.M., Gutierrez, H.R., Lu, Y., Bahalim, A.N., Farzadfar, F., Riley, L.M. and Ezzati, M. (2011) National, regional, and global trends in body-mass index since 1980: Systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. *Lancet* **377**, 557-567.
- Fulgini, A.J. and Eccles, J.S. (1993) Perceived parent-child relationships and early adolescents' orientation toward peers. *Developmental Psychology* **29**, 622-632.
- Grolnick, W.S., Ryan, R.M. and Deci, E.L. (1991) The inner resources for school achievement: Motivational mediators of children's perceptions of their parents. *Journal of Educational Psychology* **83**, 508-517.
- Hagger, M.S. and Chatzisarantis, N.L.D. (2012) Transferring motivation from educational to extramural contexts: a review of the trans-contextual model. *European Journal of Psychology of Education* **27**, 195-212.
- Hagger, M.S., Chatzisarantis, N.L.D., Barkoukis, V., Wang, C.K.J. and Baranowski, J. (2005) Perceived autonomy support in physical education and leisure-time physical activity: A cross-cultural evaluation of the trans-contextual model. *Journal of Educational Psychology* **97**, 376-390.
- Hagger, M.S., Chatzisarantis, N.L.D., Culverhouse, T. and Biddle, S.J.H. (2003) The processes by which perceived autonomy support in physical education promotes leisure-time physical activity intentions and behaviour: A trans-contextual model. *Journal of Educational Psychology* **95**, 784-795.
- Hagger, M., Chatzisarantis, N.L.D., Hein, V., Soós, I., Karsai, I., Lintunen, T. and Leemans, S. (2009) Teacher, peer, and parent autonomy support in physical education and leisure-time physical activity: A trans-contextual model of motivation in four cultures. *Psychology and Health* **24**, 689-711.
- Hox, J.J. (2002) *Multilevel Analysis: Techniques and Applications*. Lawrence Erlbaum Associates, Mahwah, NJ.
- Hu, L. and Bentler, P.M. (1999) Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modelling* **6**, 1-55.
- Institute of Medicine (2012) *Accelerating progress in obesity prevention solving the weight of the nation. Recommendation*. Available from URL: http://www.iom.edu/~media/Files/Report%20Files/2012/APOP/APOP_insert.pdf
- Jaakkola, T., Liukkonen, J., Ommundsen, Y. and Laakso, T. (2008) The relationship between situational and contextual self-determined motivation and physical activity intensity as measured by heart rates during ninth grade students' physical education classes. *European Physical Education Review* **14**, 13-31.
- Kalaja, S., Jaakkola, T., Watt, A., Liukkonen, J. and Ommundsen, Y. (2009) The associations between seventh grade Finnish students' motivational climate, perceived competence, self-determined motivation and fundamental movement skills. *European Physical Education Review* **5**, 315-335.
- Lonsdale, C., Sabiston, C.M., Raedeke, T.D., Ha, A.S.C. and Sum, R.K.W. (2009) Self-determined motivation and students' physical activity during structured physical education lessons and free choice periods. *Preventive Medicine* **48**, 69-73.
- MacCallum, R.C., Browne, M.W. and Sugawara, H.M. (1996) Power Analysis and Determination of Sample Size for Covariance Structure Modeling. *Psychological Methods* **1**, 130-149.
- Muthén, B. (1994) Multilevel covariance structure analysis. *Sociological Methods & Research* **22**, 376-398.
- Ntoumanis, N. (2001) A self-determination approach to the understanding of motivation in physical education. *British Journal of Educational Psychology* **71**, 225-243.
- Ntoumanis, N., Barkoukis, V. and Thøgersen-Ntoumani, C. (2009) Developmental trajectories of motivation in physical education: Course, demographic differences, and antecedents. *Journal of Educational Psychology* **101**, 717-728.
- Ntoumanis, N., Pensaard, A., Martin, C. and Pipe, K. (2004) An idiographic analysis of amotivation in compulsory school physical education. *Journal of Sport & Exercise Psychology* **26**, 197-214.
- Pelletier, L.G., Fortier, M.S., Vallerand, R.J. and Briere, N.M. (2001) Associations among perceived autonomy support, forms of self-regulation, and persistence: A prospective study. *Motivation and Emotion* **25**, 279-306.
- Pelletier, L.G., Fortier, M.S., Vallerand, R.J., Tuson, K.M., Briere, N.M. and Blais, M.R. (1995) Toward a new measure of intrinsic motivation, extrinsic motivation, and amotivation in sports: The Sport Motivation Scale (SMS). *Journal of Sport and Exercise Psychology* **17**, 35-53.
- Pelletier, L.G., Meredith, A.R., Vallerand, R.J., Deci, E.L. and Ryan, R. (2013) Validation of the revised sport motivation scale (SMS-II). *Psychology of Sport and Exercise* **14**, 329-341.
- Ryan, R. (1995) Psychological needs and the facilitation of integrative processes. *Journal of Personality* **63**, 39-427.
- Ryan, R.M. and Deci, E.L. (2008) Self-determination theory and the role of basic psychological needs in personality and the organization of behaviour. In: *Handbook of personality: Theory and research*. Eds: John, O.P., Robbins, R.W. and Pervin L.A. New York, NY: The Guilford Press. 654-678.
- Ryan, R.M. and Connell, J.P. (1989) Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology* **57**(5), 749-761.
- Sallis, J.F., McKenzie, T.L., Beets, M.W., Beighle, A., Erwin, H. and Lee, S. (2012) Physical education's role in public health: Steps forward and backward over 20 years and hope for the future. *Research Quarterly for Exercise and Sport* **83**, 125-135.
- Shen, B., Li, W., Sun, H. and Rukavina, P. (2010) The influence of

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- Spray, C., Warburton, V.E. and Stebbings, J. (2013) Change in physical self-perceptions across the transition to secondary school: Relationships with perceived teacher-emphasised achievement goals in physical education. *Psychology of Sport and Exercise* **14**, 662-669.
- Strong, W.B. et al. (2005) Evidence based physical activity for school-age youth. *Journal of Pediatrics* **146**, 732-737.
- Sun, H. and Chen, A. (2010). A pedagogical understanding of the self-determination theory in physical education. *Quest* **62**, 364-384.
- Standage, M., Duda, J.L. and Ntoumanis, N. (2003) A model of contextual motivation in physical education: Using constructs from self-determination and achievement goal theories to predict physical activity intentions. *Journal of Educational Psychology* **95**, 97-110.
- Warburton, D.E., Nicol, C.W. and Bredin, S.S. (2006) Health benefits of physical activity: the evidence. *Canadian Medical Association Journal* **174**, 801-809.
- Wigfield, A., Byrnes, J.B. and Eccles, J.S. (2006) Adolescent development. In: *Handbook of educational psychology*. Eds: Alexander, P.A. and Winne, P. 2nd edition. Mahwah, NJ: Erlbaum. 87-113.
- Wigfield, A. and Eccles, J.S. (2000) Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology* **25**, 68-81.
- Wigfield, A., Eccles, J.S., MacIver, D., Reuman, D.A. and Midgley, C. (1991) Transitions during early adolescence: Changes in children's domain specific self-perceptions and general self-esteem across the transition to junior high school. *Developmental Psychology* **27**, 552-565.
- Williams, G.C. and Deci, E.L. (1996) Internalization of biopsychosocial values by medical students: A test of self-determination theory. *Journal of Personality and Social Psychology* **70**, 767-779.
- Yli-Piipari, S. (2014). Physical education reform in Finland. *Quest* **4**, 468-484.
- Yli-Piipari, S., Kiuru, N., Jaakkola, T., Liukkonen, J. and Watt, A. (2011) The role of peer groups in male and female adolescents' task values and physical activity. *Psychological Reports* **108**, 1-19.

Key points

- Students' identified regulation increased across Grades 6 to 9.
- Students' amotivation increased across middle school transition from Grade 6 to 7.
- Students' introjected regulation declined from Grade 8 to 9.
- Other motivational regulations remained stable across time.

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