CHAPTER 8

The development of performance for secondary school students in PE, in association with autonomy support, need satisfaction, motivation, and learning strategies

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ABSTRACT

How does students' motivation change throughout secondary school and influence outcomes like performance, participation, and exertion in PE? This question is answered by: (1) looking at the correlations between change scores for motivation variables, learning strategies, and performance, participation, and exertion outcomes in physical education (PE) throughout three years of secondary school, (2) analyzing mean changes in motivation regulations, learning strategies, and outcome variables over the three years, and (3) applying a person-centered approach to look at different sub groups in the development of performance, exertion, and participation. In the study, 86 Grade 8 students participated at Time 1 and 65 of these students completed the study in Grade 10. Quantitative measurements were conducted at three time points using questionnaires. Correlations between changes in autonomy support and need satisfaction measured early in secondary school and changes in autonomous motivation measured later in secondary school were significantly positively associated. In turn, changes in autonomous motivation were significantly positively related to changes in learning strategies,

which were significantly positively related to changes in exertion and performance in PE. A one-way repeated measured analysis of variance (ANOVA) indicated that a significant decrease was found for external regulation, whereas increases were found for absorption, effort regulation, help seeking, and exertion over time. A latent class growth analysis (LCGA) identified two different trajectories of performance among students – one in which performance was improved and one in which performance was stable. Covariates associated with performance class membership at Time 1 and Time 3 indicate that the probability of being in Trajectory 1 ("increase/improvement") rather than Trajectory 2 ("stable"), increases when the students are higher in autonomy support, autonomous motivation, need satisfaction, perceived competence, absorption, and effort regulation.

INTRODUCTION

Physical education (PE) aims to develop students' knowledge and skills for lifelong participation in physical activity (PA), yet many PE teachers report that motivating students is a significant challenge. Research on motivation is central for understanding why some students lack interest, show little effort, and display boredom in school, and why others exhibit high levels of engagement. Secondary students go through much change. It is of importance to look at how different motivational drives develop, change, and influence each other in this phase – the more time students spend in school, the less they become intrinsically motivated. PE teachers' motivational styles and practices have a huge impact on students and their engagement in learning, and can encourage students to adopt an active lifestyle (Wright, Patterson & Cardinal, 2000). Ideally, PE fosters learning about exercise and training, lifestyle, and health, and motivates students to adopt an active life in adulthood (Utdanningsdirektoratet, 2015).

This study uses Self-Determination Theory (SDT) as a theoretical framework to examine the importance of motivational factors and learning strategies in influencing performance, participation, and exertion throughout secondary school in PE. Deci and Ryan (2017) state that the central principles of SDT are important for PE, and that research based on the different mini theories of SDT may help educators and teachers to meet the goals of PE. In the following section, the self-determination theory and the concept learning strategies with some examples of previous research are presented.

Self-Determination Theory (SDT)

Over the last 40 years, Self-Determination Theory (SDT) has become a main theory of human behavior (Gagne & Deci, 2014). SDT is an empirically based theory of human motivation, development, and wellness (Ryan & Deci, 2002). The theory is focused on how social, biological, and cultural conditions either enhance or undermine inherent human capacities for engagement, wellness, and psychological growth in specific domains, and is concerned with the social conditions that facilitate or hinder human flourishing (Ryan & Deci, 2017). The organismic perspective of SDT is based on the assumption that humans have evolved to be physically active, inherently curious, and social beings. The theory is concerned with how social-contextual factors support or thwart peoples' ability to thrive through the satisfaction of their basic psychological needs for autonomy, relatedness, and competence (Ryan & Deci, 2017).

AUTONOMY SUPPORT AND NEED SATISFACTION

Teachers' autonomy support includes offering choice, minimization controlling language, and provision of a meaningful rationale for being active (Deci, Eghrari, Patrick & Leone, 1994; Reeve & Jang 2006). Teachers who are supportive of autonomy rather than controlling have students who are higher in need satisfaction and who are more autonomously motivated (Cheon, Reeve & Moon, 2012). In SDT, three universal and inherent psychological needs are identified that are required for optimal development and psychological health (Deci & Vansteenkiste, 2004). These needs are the need for competence, autonomy, and relatedness, (Deci & Ryan, 2008a). The need for autonomy is not the same as individualism, detachment, or independence. It is about volition and endorsement of one`s behavior (Deci & Ryan, 1985; Deci & Ryan, 2000). The need for competence refers to experiencing opportunities to express and exercise one`s capacities, and the feeling of being effective when interacting with the environment (White, 1959). The need for relatedness concerns the feeling of caring for, and being cared for by others, both individuals and groups (Baumeister & Leary, 1995). These three needs are considered sufficient and necessary to promote human growth and functioning (Deci & Ryan, 2000). Perception of autonomy, competence, and relatedness, together with self-determined motivation, enjoyment, and physical activity in PE also predict leisure time physical activity (Cox, Smith & Williams, 2008).

Soccer players, aged 11 to 18, in a study by Adie, Duda, and Ntoumanis (2012), perceived their coaches to be high and stable in both autonomy support and need satisfaction throughout two seasons. Perceived autonomy support also predicted changes between mean differences and changes within the basic psychological needs for relatedness, autonomy, and competence. In this study, players who perceived the highest degree of autonomy support displayed the highest change in basic need satisfaction. This also indicates that autonomy support has the potential to satisfy all three needs. In a longitudinal study in PE by Cheon et al. (2012), students were followed over one semester. The students' autonomy support first decreased and then leveled out. The need for autonomy remained unchanged, the need for competence increased, and the need for relatedness decreased and then leveled out. In a study of Greek junior high school students in PE, there was a significant decrease over time for the relatedness need (Ntoumanis, Barkoukis & Thøgersen, 2009).

Motivational Regulations

Within the self-determination continuum described in Deci and Ryan (1985), organismic integration theory represents differences in the ways in which behavior can be regulated and how these differences are experienced. SDT views the quality of motivation as more important than the amount of motivation for predicting outcomes, and a central point in SDT is the degree to which motivation is autonomous versus controlled. Autonomous motivation is when people have internalized the value of certain things and activities (Deci & Ryan, 2008). Autonomous motivation leads to many positive outcomes such as long-term persistence, healthy behavior, and effective performance (Deci & Ryan, 2008). Controlled motivation consists of external regulation and introjected regulation, and the behavior is motivated by external rewards and avoidance of punishments, or by shame and ego-involvement. People with controlled motivation feel pressured to behave or think in particular ways (Deci & Ryan, 2008).

Intrinsic and extrinsic motivation plays a huge role in predicting educational outcomes. Intrinsic motivation has been found to correlate with test scores at different levels at school (Lepper, Corpus & Iyengar, 2005), while extrinsic motivation has been found to negatively correlate with academic outcomes (Lepper, Corpus & Iyengar, 2005). Gillet, Vallerand, and Lafreniere (2012) investigated

intrinsic and extrinsic school motivation in 1600 students aged 9-17. They found a decrease in intrinsic motivation and self-determined extrinsic motivation from 9-12 years, stabilization up to 15 years, and then an increase up to 17 years. Non-self-determined extrinsic motivation decreased up to 12 years and then stabilized. Otis, Grouzet, and Pelletier (2005) found that intrinsic motivation and extrinsic motivation gradually decreases between Grades 8-10. In Greek junior high school, teachers observed a decrease in intrinsic and identified motivation and found that introjected and external regulation was stable over time (Ntoumanis, Barkoukis & Thøgersen, 2009). Corpus, McClintic-Gilbert, and Hayenga (2009) found that intrinsic motivation was higher among Grade 3 students than in Grade 8 students, with changes occurring in a single year. The same trends were reported by Lepper, Corpus, and Iyengar (2005), who found a linear decrease in intrinsic motivation from Grades 3-8, but not a significant decrease for extrinsic motivation. A three-year investigation at junior high in Greece showed a decrease in intrinsic and identified regulation, an increase in external regulation, and stability in introjected regulation (Barkoukis, Taylor & Ntoumanis, 2014). In a study of Japanese high school students, intrinsic and identified regulations decreased, and external and introjected regulations increased during junior high school. Profile analysis showed that some students showed only a decrease in autonomous motivation, while others showed only increase in controlled motivation (Nishimura & Sakurai, 2017).

Learning Strategies

Effort regulation is important to academic success because it not only signifies goal commitment, but also regulates learning strategies (Pintrich, Smith, Garcia & McKeanchie, 1991). Effort regulation is one of the resource management strategies that work as motivational beliefs and that promote and sustain different aspects of self-regulated learning (Pintrich, 1999). Change in intrinsic motivation and identified regulation positively predicts change in effort (Taylor, Ntoumanis, Standage & Spray, 2010).

Peer learning has been found to have a positive impact on achievement, and dialogue can help clarify material and reach insights one may not have attained on one's own (Pintrich, Smith, Garcia & McKeanchie, 1991). Help seeking from peers and the instructor is important – peer help, peer tutoring, and individual teacher assistance all facilitate student achievement (Pintrich et al., 1991).

Task absorption helps people concentrate on an activity. Mental focus is positively related to performance and enjoyment for students (Lee, Sheldon & Turban, 2003). Task absorption or involvement has been shown to be positively associated with intrinsic motivation and to lead to more free-choice puzzle solving, more time spent on the activity, and enjoyment (Cury, Elliot, Sarrazin, Da Fonseca & Rufo, 2002; Elliot & Harackiewicz, 1996). There is a positive correlation between absorption and participation in art education in university students (Wild, Kuiken & Schopflocher, 1995). A study among medical students found significant positive associations between study effort and academic performance (i.e., grades) for males (Kusurkar, Ten Cate, Vos, Westers & Croiset, 2013). Lynch (2006) reported that effort-regulation strongly predicted course grades for freshman and upper level college students. Effort as a learning strategy predicted final grades and performance in the lab among college students (Lynch, 2010).

THE PRESENT STUDY

The theory and research presented above link the different measures used in this study together, and show the importance of each of the variables for enhancing motivation and important outcomes in PE. Hence, the overall question for this study is: How do important motivational factors and learning strategies influence change in outcomes such as performance, participation, and exertion throughout secondary school in PE? This question is answered by: (1) looking at correlations between change scores for motivation variables, learning strategies, and performance, participation, and exertion in physical education (PE) throughout three years of secondary school, (2) analyzing mean changes in motivation regulations, learning strategies, and outcome variables over the three years, and (3) applying a person-centered approach to look at different sub groups in the development of performance, exertion, and participation.

The person-centered approach was explorative, but finding three groups was expected: students who increased their performance, exertion, and participation, students who decreased their performance, exertion, and participation, and students who maintained their level of performance, exertion, and participation throughout secondary school. Different groups were hypothesized to show different scores for autonomy support, need satisfaction, autonomous motivation, controlled motivation, and learning strategy use.

METHOD

Participants

In the study, 86 Grade 8 students participated at T1, and 65 of the same students completed the study in Grade 10. The PE teacher was the same for all of the three years. Quantitative measurements were conducted at three time points using questionnaires. Students responded to a questionnaire package in late February every year, just after receiving their semester grades. The questionnaire was completed in class with one teacher reading the questions out loud.

Translation of Measures

All questionnaire measures described below were translated to Norwegian, and back-translated to English, and adapted following the procedures suggested by Beaton, Bombardier, Guillemin, and Ferraz (2000).

1) Perceived autonomy support was measured with a short version of the Sport Climate Questionnaire (SCQ) adapted to physical activity from Williams, Grow, Freedman, Ryan, and Deci (1996), which shows good consistency and validity in Norway (Solberg & Halvari, 2009). The questions were modified to assess students' perception of the degree to which their teachers are autonomy supportive in physical education classes. Students respond to 6 items on a 1-7 scale. Two example items are: "My teacher encourages me to ask questions" and "I feel that my teacher understands me."

2) Psychological need satisfaction was measured with the 12-item "Basic Psychological Needs in Exercise Scale" (BPNES; Vlachopoulos & Michailidou, 2006), with four items measuring each of the three needs (i.e., the needs for competence, relatedness, and autonomy). Three sample items are: "I feel very much at ease with the other participants in physical education" (relatedness), "I feel I have been making huge progress with respect to the end result I pursue in physical education" (competence), and "physical education is highly compatible with my choices and interests" (autonomy). Participants responded to the items on a 7-point Likert-scale ranging from 1 (*not true at all*) to 7 (*very true*).

3) Motivation was measured with the self-regulation Questionnaire (SRQ) (Ryan & Conell, 1989). Items measuring identified and intrinsic regulation (14 items) were computed to form autonomous motivation. Students were asked to respond to reasons behind participating in physical education. There were

the following questions. "Why do you participate in physical education?" "Why do you work hard in physical education?" "Why do you train for difficult things in physical education?" "Why do you want to do well in physical education?" Students responded on a 1-4 scale. Example items are: "I participate because it`s fun" (intrinsic regulation), and "I want to learn and understand more" (identified regulation), "I want the teacher to think I am a good student" (introjected regulation), and "I get in trouble if I don't" (external regulation). Reliability and validity were satisfied (Halvari, Ulstad, Bagøien & Skjesol, 2009; Cock & Halvari, 2001).

4) Learning strategies were measured with three resource management strategies from the Motivated Strategies for Learning Questionnaire (MSLQ: Pintrich, Smith, Garcia & McKeanchie, 1991), namely effort regulation, peer learning, and help seeking. Sample items are: "Even when tasks in physical education are dull and uninteresting, I manage to keep working until I finish" (effort regulation), "I try to work with other students from this class to complete the tasks and activities" (peer learning), and "When I can't understand the tasks and exercises in physical education, I ask another student in this class for help" (help seeking).

A fourth learning strategy, absorption, was measured with the 3-item Absorption Scale (Elliot, Murayama & Pekrun, 2011). Absorption involves students using the time in class to concentrate on appropriate tasks, which is a skill related to a resource management learning strategy labeled time and study environment regulation (Pintrich et al., 1991). A sample item: "In this physical education class I concentrate on fulfilling the tasks." Participants responded to the items on a 7-point Likert-type scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*).

5) Participation in physical education was measured by one question about how often students participate, ranging from (1) almost never to (4) very often.

6) Performance was measured by self-reporting grades and expectation of grades using the following two questions. "What grade did you get this semester?" "What grade do you expect to get next semester?"

7) Exertion in physical education was measured on a 5-point scale ranging from (1) "I do not exert myself" to (5) "I exert myself very much". This scale is developed from the Rating of Perceived Exertion Scale (RPE-Scale; Borg & Ottoson, 1986).

DATA ANALYSIS

Correlations between variables at each time-point and between change-scores were performed. Drop out analysis (one way ANOVA) was conducted to test for differences between those participating at all three time points (n = 69) with those only answering at T1, and T1 and T2 and T1 and T3. No significant differences between the groups were found. Further analysis was done with 65 students in ANOVA and with 86 students in the Mplus analysis.

A one-way repeated measured analysis of variance (ANOVA) was performed to look at changes over time for each variable, together with a follow up comparison to look at pairwise differences on each time-point.

Mplus (Version 7.3; Muthén & Muthén, 2007) was used to perform a latent class growth analysis (LCGA). LCGA is a statistical method used to analyzing longitudinal data in order to identify distinct trajectories (Jung & Wickrama, 2008). In this study, different trajectories were identified for performance, participation, and exertion. To identify the trajectories, the variance of the slope was fixed to zero, and the variance in the intercept was free. This was done to get a restrictive model. Several criteria were used to evaluate model estimation fit and to decide on the number of latent classes: the highest possible entropy (values close to 1 indicate high classification accuracy, and values close to 0 indicate low certainty), and significant results on the Bootstrap Likelihood Ratio Test (BLRT), the smallest Bayesian Information Criteria (BIC) and the smallest Aikaike`s Information Criterion (AIC) (Jung & Wickrama, 2008; Nylund, Aspaoutiov & Muthén, 2007).

RESULTS

Descriptive Statistics, and Reliability

In Table 8.1, means and reliabilities are presented for all the variables at Time 1, 2, and 3. All variables yielded good reliability estimates with values above .70 (Ponterotto & Ruckdeschel, 2007), except absorption and effort regulation at Time 1, with alpha values = .64 and = .56. Peer learning had values at .51, .42, and .38. This is below the recommended values regarding this sample size and is unsatisfactory (Ponterotto & Ruckdeschel, 2007); therefore, the variable peer learning was taken out of further analysis.

Table 8.1 Means, Standard Deviations and Reliability Coefficients (α) for Variables at Time 1, 2, and 3; N = 65.

	T1	SD	α	T2	SD	α	T3	SD	α
Autonomy Support	4.62	1.29	.91	4.44	1.26	.91	4.71	1.31	.92
Autonomy	5.15	.98	.75	4.93	1.20	.89	4.99	1.21	.84
Relatedness	5.86	1.24	.94	6.01	1.10	.92	6.10	.97	.74
Competence	5.36	1.08	.83	5.46	.97	.78	5.62	.88	.84
Need Satisfaction	5.46	.91	.76	5.47	.97	.85	5.57	.89	.83
Intrinsic Regulation	3.41	.59	.92	3.42	.58	.91	3.41	.48	.79
Identified Regulation	3.40	.47	.79	3.40	.50	.84	3.36	.54	.84
Introjected Regulation	2.30	.51	.76	2.41	.54	.75	2.24	.49	.69
External Regulation	2.29	.51	.76	2.25	.49	.73	2.02	.46	.68
Absorption	4.64	1.25	.77	4.69	1.29	.85	5.18	1.19	.83
Effort Regulation	5.60	1.06	.76	5.64	1.13	.86	5.93	.89	.81
Peer Learning	4.28	1.03	.51	4.83	.92	.42	4.93	.79	.38
Help Seeking	4.88	.81	.51	5.28	.95	.57	5.32	1.02	.74
Exertion	3.45	.69	–	3.66	.70	–	3.97	.73	–
Performance	4.37	.60	.69	4.45	.62	.75	4.51	.66	.70
Participation	3.78	.57	–	3.86	.43	–	3.88	.48	–

Correlations

Correlations between change-scores (Table 8.2) are in line with SDT research. Correlations between changes in need satisfaction (T1–T2) are significantly positively correlated with change in autonomy support (T1–T2). Both autonomy support (T1–T2) and need support (T1–T2) are significantly positively associated with autonomous motivation (T1–T2 and T1–T3). Change in autonomous motivation (T1–T3) is correlated with change in all of the learning strategies (T1–T3), and change in learning strategy use (T1–T3) is correlated with change in performance and exertion (T1–T3). Change in participation is uncorrelated to change in learning strategy use.

Table 8.2 Pearson Correlations Among Variables of Change (T1 – T2 – T3).

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Autonomy support T1–T2												
2. Needs T1–T2	.38**											
3. Autonomy T1–T2	.48**	.87**										
4. Competence T1–T2	.08	.62**	.47**									
5. Relatedness T1–T2	.17	.84**	.55**	.53**								
6. Autonomous Motivation T1–T2	.31*	.55**	.65**	.28*	.33**							
7. Autonomous Motivation T1–T3	.25*	.21	.30*	.41**	.30**	.35**						
8. Absorption T1–T3	.06	.20	.24	.45**	.10	.28*	.58**					
9. Effort Regulation T1–T3	.18	.33**	.27*	.49**	.25*	.15	.36**	.36**				
10. HelpSeek T1–T3	.08	–.05	–.01	.13	–.10	.22	.39**	.46**	.14			
11. Performance T1–T3	.24	.36**	.33**	.59**	.23	.16	.54**	.32*	.39**	.28*		
12. Participation T1–T3	.19	.27*	.28*	.06	.28*	.12	.13	–.02	–.02	.07	.26*	
13. Exertion T1–T3	.32**	.31*	.34*	.36**	.13	.29*	.47**	.49**	.33**	.33**	.29*	.07

Change scores (standardized residuals) were estimated by regression of T2 measures onto T1 Measures and T3 measures onto T1 measures.

*p < .05. ** p < .01 N = 65

ANOVA Repeated Measures

A significant time effect (Wilks' Lambda = .76 $F_{2,65}$ = 9.81, p<.001) is shown for external regulation, with a decrease from T1-T3 and T2-T3 (T1-T2 is not significant). A significant time effect (Wilks' Lambda = .78 $F_{2,65}$ = 9.15, p <.001 is also shown for absorption, with an increase from T1-T3 and T2-T3 (T1-T2 is not significant).

Further, a significant time effect (Wilks' Lambda = .85 $F_{2,65}$ = 5.57, p < .01 is shown for effort regulation, with increases from T1-T3 and T2-T3 (T1-T2 is not significant). In addition, a significant time effect (Wilks' Lambda = .80 $F_{2,65}$ = 7.90, p < .001 is shown for help seeking, with increases from T1-T2 and T1-T3 (T2-T3 is not significant). Finally, a significant time effect (Wilks' Lambda = .66 $F_{2,65}$ = 16.38, p < .001) for exertion was found, with increases from T1-T3 and T2-T3 (T1-T2 is not significant). All other variables had non-significant changes.

Determination of Number of Latent Classes

Two different trajectories of performance among students were identified. In Table 8.3, the fit indices for the different number of latent classes from the LGCA are presented. A two-class solution was chosen because of the lowest BIC value and a significant BLRT value for 2 versus 3 classes. A three-class solution had a higher entropy and a smaller AIC than the two-class solution, but because of the small number of participants (n = 3) in one of the groups in the three-class solution it was more meaningful to choose the two-class solution. Trajectory 1 consisted of 35 participants (41%) and is called "stable" (Intercept: M = 4.16, SE = .08, p = < .001; Slope: M = .01, SE = .07, p = .91). Trajectory 2 consisted of 51 participants (59%) and is called "increase" (Intercept: M = 4.80, SE = .08, p = <.000; Slope: M = .16, SE = .03, p = <.000). Regarding exertion and participation, no trajectories were identified due to significant BLRT value for only the one-class solution, and a small number of participants when looking at other class solutions.

Table 8.3 Fit Indices for Latent Growth Class Models of Performance for Different Number of Trajectories.

No. of Classes	No. of free parameters	AIC	BIC	BLRT (p – value)	Entropy	Latent class proportion (%)
1	6	287.68	302.40			
2	9	273.67	295.76	.075	.77	41/59
3	12	267.64	297.09	.003	.85	3/38/59
4	15	265.88	302.68	.67	.81	50/23/2/11

Note. N = 86. AIC = Aikaike's information criterion; BIC = Bayesian information Criterion; BLRT; Bootstrap Likelihood Ratio Test

Covariates Associated to Performance Class Membership at T1 and T3

In Table 8.4, descriptive statistics for all covariates in both of the trajectories at T1 and T3 are presented. Results from the multinomial logistic regressions are presented in Table 8.5, with coefficient differences for trajectory group membership, and odds ratio on eight independent variables at T1 and T3. At T1, the probability of being in Class 2 ("increase") rather than Class 1 ("stable") increases when the students are higher in autonomy support, autonomous motivation, need satisfaction, perceived competence, absorption, and effort regulation. At T3, the probability of being in Class 2 ("increase") rather than Class 1 ("stable") increases when students are higher in the same variables as T1. Controlled motivation and help seeking were not significant in predicting membership in any of the two trajectories.

Table 8.4 Descriptive Statistics for Covariates for the Latent Trajectory Classes of Performance at T1 and T3.

	Class 1 T1 Stable n = 35	Class 1 T3 Stable n = 35	Class 2 T1 Increase n = 51	Class 2 T3 Increase n = 51
Autonomy Support	4.0 (1.15)	4.0 (1.27)	4.9 (1.40)	5.1 (1.11)
Need Satisfaction	4.9 (.90)	5.0 (.86)	5.7 (.82)	6.0 (.62)
Perceived Competence	5.3 (1.05)	5.3 (.79)	6.2 (.81)	6.3 (.58)
Autonomous Motivation	3.2 (.55)	3.2 (.44)	3.5 (.37)	3.6 (.43)
Controlled Motivation	2.4 (.46)	2.2 (.49)	2.2 (.45)	2.1 (.44)
Absorption	3.9 (.97)	4.6 (1.24)	4.9 (1.19)	5.6 (.92)
Effort Regulation	5.2 (1.27)	5.5 (.84)	5.8 (.94)	6.3 (.72)
Help Seeking	4.8 (.78)	5.1 (1.16)	4.9 (.81)	5.5 (.83)
Performance	4.2 (.46)	4.2 (.33)	4.8 (.36)	5.2 (.26)
Exertion	3.3 (.73)	3.7 (.80)	3.5 (.61)	4.1 (.61)
Participation	3.5 (.79)	3.7 (.76)	3.9 (.41)	4.0 (.15)

Table 8.5 Predictors of Membership in the Latent Trajectory Classes of Performance (Class 1 = Stable, Class 2 = Increase).

	Class 2 vs 1 at T1 Coeff OR		Class 2 vs 1 at T3 Coeff OR	
Autonomy Support	.51*	1.66	.77**	2.17
Need Satisfaction	1.13**	3.10	1.79**	6.00
Perceived Competence	1.08**	2.93	2.03**	7.64
Autonomous Motivation	1.83*	6.22	2.20*	8.99
Controlled Motivation	–.91	.40	–.59	.56
Absorption	.83**	2.28	.92**	2.51
Effort Regulation	.55*	1.74	1.32**	3.74
Help Seeking	.25	1.29	.45	1.57

*p < .05; **p < .001. Coeff = Coefficient; OR = Odds ratio; N = 85

DISCUSSION

The main purpose of the present research was to answer the following research question: How do important motivational factors and learning strategies influence changes in performance, participation, and exertion throughout secondary school in PE? This question was answered by looking at correlations between change in scores for motivation variables, learning strategies, and outcomes in physical education (PE) throughout three years of secondary school, change in scores between mean values, and if different trajectories were emerging when looking at the development of performance, participation, and exertion in students.

From an SDT perspective, and based on a supported SDT process model in PE courses in Grades 8–10 (Ulstad, Halvari, Sørebø & Deci, 2016), some correlations between motivational constructs can be expected. In Ulstad, Halvari, Sørebø, and Deci (2016), autonomy support from teachers was positively related to basic psychological need satisfaction. Need satisfaction was positively related to autonomous motivation and perceived competence, both of which were positively related to learning strategy use. Finally, learning strategy use was positively related to the level of participation and the performance (i.e., grades) in PE. Both performance and participation were hypothesized to increase when increases occur in the use of learning strategies. What we see in this study

regarding correlations between change scores is a similar tendency, supporting the SDT process model of participation and performance in PE. Correlations between changes in autonomy support and need satisfaction measured early in secondary school and changes in autonomous motivation measured later in secondary school were significantly positively associated. In turn, changes in autonomous motivation were significantly positively related to changes in learning strategies, which were significantly positively related to changes in exertion and performance in PE. This indicates that students who perceive their teacher to be more autonomy supportive experience more need satisfaction and autonomous motivation. Becoming more autonomy motivated seems to lead to use of those learning strategies that improve performance and levels of exertion in PE. This highlights the importance for secondary school teachers to be autonomy supportive towards their students. As we see from the ANOVAs, perceived autonomy support stayed at the same level throughout secondary school for the whole group of students. Students who increased their performance also reported an increase in perceived autonomy support. This indicates that teachers should try to reach out to more of the students to be perceived as more autonomy supportive.

The overall results from ANOVAs for the whole group of students (n = 65) for the three years indicates that students' perception of teachers' autonomy support is the same between Grades 8–10. Students' need satisfaction and motivational regulations (except external regulation) also seems to stay at the same level. This lack of change is significant in all three years. This is better than expected because other studies (e.g., Gillet, Vallerand & Lafreniere, 2012; Otis, Grouzet & Pelletier, 2005; Gottfried, Flemming & Gottfried, 2001) report a decrease especially in students' motivational regulations throughout secondary school. Some other studies include different subjects in their analysis, which may have led to different results. A strength in this study is that it only measured the different variables for PE. With a stable mean of 3.4 on a 5-point scale on intrinsic and identified regulation, the students were demonstrated as being quite high in autonomous motivation, which may lead to a range of positive outcomes (Deci & Ryan, 2008).

Regarding autonomy support and need-satisfaction, there seems to be a decline in secondary school in students' self-reports in the literature. Differences

can occur between the different needs (Cheon, Reeve & Moon, 2012; Ntoumanis, Barkoukis & Thøgersen, 2009), but the tendency is that they decrease. With a mean of 4.6 on a 7-point scale for autonomy support and a stable mean of 5.5 for need satisfaction, the students in this study seem to be in an environment that enhances autonomous motivation in PE. The satisfaction of the three needs is important for human growth and functioning (Deci & Ryan, 2000; Deci & Vansteenkiste, 2004).

All of the learning strategies (absorption, effort regulation, and help seeking) showed significant positive changes over time. All students were high in learning strategies, and they learned to use these learning strategies even more as they progress in secondary school. This should help them to perform better (Kusurkar, Ten Cate, Vos, Westers & Croiset, 2013; Lynch, 2010), and participate more (Wild, Kuiken & Schopflocher, 1995). Some differences seem to occur between the different learning strategies. Help seeking increased between Grades 8 and 9, while absorption and effort regulation increased between Grades 9 and 10. Exertion and effort regulation changed significantly, mostly in Grades 9 and 10. This may have something to do with the final grade students get in Grade 10. The assessment in Norway may also be quite different than in other countries, and this may play a role in enhancing effort regulation and exertion. Students' effort in PE is part of their basic subject assessment. This is often communicated to students and is highlighted as important for those wanting to improve their grades.

Overall, it seems like the students' development in autonomy support, need satisfaction, and motivational regulations are stable over time. The learning strategies seem to change positively.

What do we see regarding the same variables if we look at the two trajectories that emerge from the LCGA analysis? Results from LCGA show a more nuanced picture of the development of performance in sub-populations of students in secondary school PE. One trajectory with 35 students is labeled "stable." In this group performance is at the same level throughout secondary school and starts at a lower level than in the other group in Grade 8. The other trajectory with 51 students is labeled "increasing". The students in that group have an increase in their performance throughout secondary school and they also start higher in performance in Grade 8.

If we look at these two trajectories and how they relate to the other variables, we get a more nuanced look at the development of performance. Students who increase their performance are likely to have a higher perception of autonomy support, higher need satisfaction, and higher autonomous motivation. Students who have a stable performance throughout secondary school are likely to have a lower perception of autonomy support, lower satisfaction of needs, and lower autonomous motivation. Regarding the use of learning strategies, being high in absorption and effort regulation puts students in the "increase" group. Being high in help seeking and controlled motivation does not significantly put students in either of the two trajectories.

The group that is stable in performance is also stable in autonomy support, need satisfaction, perceived competence, and motivational regulation. The students with increased performance are also quite stable in autonomy support, need satisfaction, perceived competence, and autonomous motivation, but at a higher level. In Grade 10, the "increase" group is 1.0 above the "stable" group in mean values on autonomy support, need satisfaction, and perceived competence. Indeed, the reason for the increase in performance in one group may be because of a higher level of autonomy support, perceived competence, and need satisfaction together with a higher mean level in absorption and effort regulation.

It seems that being high in performance in Grade 8 is important for increased performance throughout secondary school. Motivational constructs such as autonomy support, need satisfaction, and autonomous motivation seem to stay at the same level, but when it comes to the use of learning strategies, we see an increase in this group. This, together with a higher level of autonomy support may explain the change in performance that occurs. Students showing more absorption, effort regulation, and more help seeking perform better.

The results from this study emphasize the importance of autonomy support and the importance of facilitating need satisfaction among students, especially those who show lower levels of performance. It is also of importance to help students use learning strategies such as effort regulation and help seeking. This study highlights the development of performance for secondary school students in PE in association with autonomy support, need satisfaction, motivation, and learning strategy use, and may contribute to the knowledge regarding what teachers can do to improve their students' performance.

Limitations and Further Research

There are several limitations in this study. All data from the students were based on self-reports. Students may have misunderstood questions or they may have tried to gain the teacher's approval. Using observed measures of students' participation and performance would have strengthened the study. Other aspects of students' motivation, such as self-efficacy, mastery goals, interest, and absorption could have led to different results. The number of participants is low for performing LCGA analysis. A higher number of participants probably would have helped in creating different sub groups, and maybe also helped in detecting trajectories regarding participation and exertion. A group of students who decreased their performance would have been of interest for analysis, and it would also have been of interest to compare students' measures on all variables in other subjects to see if there are any differences between subjects. Looking at gender differences would also have been interesting. Future research should also explore why the students in one of the groups increased their performance in a more thorough way using more participants and also measuring other variables. Regarding different academic subjects in school, there may also be differences. Gottfried, Flemming, and Gottfried (2001) found a decrease for intrinsic motivation in math and science classes, a small decrease in reading and for school in general, and no change for social studies from middle elementary throughout the high school years. Further research is needed in this area.

CONCLUSIONS

Using a LCGA person centered analysis is new with SDT variables in PE. The current study is the first to investigate different developmental trajectories for performance in PE students. The present study contributes to the SDT-based literature and shows a nuanced picture of the development of performance in different trajectories in secondary school PE, linking this development to autonomy support, need satisfaction, motivational regulation, and learning strategies. By using different approaches when analyzing the development of different motivational variables and outcomes in PE, and by considering correlations between change scores, change scores between mean values, and different trajectories, nuances are revealed that may help teachers better understand what happens in the development of performance throughout secondary school.

REFERENCES

Adie, J. W., Duda, J. L. & Ntoumanis, N. (2012). Perceived coach-autonomy support, basic need satisfaction and well and ill-being of elite soccer players: A longitudinal investigation. *Psychology of Sport and Exercise*, 13, 51-59. doi:10.1016/j.psychsport.2011.07.008.

Barkoukis, V., Taylor, J. C. & Ntoumanis, N. (2014). The relationship between student motivation and student grades in physical education: A 3-year investigation. *Scandinavian Journal of Medicine and Science in Sports,* 24, 406-414. doi:101111/sms.12174.

Baumeister, R. & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin,* 117, 497-529.

Beaton, D. E., Bombardier, C., Guillemin, F. & Ferraz, M. B. (2000). Guidelines for the process of cross-cultural adaption of self-report measures. *SPINE 25(24)*, 3186-3191. http://dx.doi.org/10.1097/00007632-200012150-00014

Borg, G. & Ottoson, D. (1986). *The perception and exertion in physical work*. Stockholm: Wenner-Gren Center.

Cheon, S. H., Reeve, J. & Moon, I. K. (2012). Experimental based, longitudinally designed, teacher-focused intervention to help physical education teachers be more autonomy supportive toward their students. *Journal of Sport and Exercise Psychology*, 34, 265-396.

Cock, D. & Halvari, H. (2001). Motivation, performance and satisfaction at school. In A. Efklides, J. Kuhl & R. M. Sorrentino (Eds.), *Trends and prospects in motivational research* (pp. 63-82). Dordrecht, The Netherlands: Kluwer Academic.

Corpus, J. H., McClintic-Gilbert, M. S. & Hayenga, A. O. (2009). Within-year change in children's intrinsic and extrinsic motivational orientations: Contextual predictors and academic outcomes. *Contemporary Educational Psychology*, 34, 154-166.

Cox, A. E., Smith, A. L. & Williams, L. (2008). Change in physical education motivation and physical education behavior during middle school. *Journal of Adolescent Health,* 43, 506-513. doi:10.1016/j.jadohealth.2008.04.020

Crede, M. & Phillips, L. A. (2011). A meta-analytic review of the Motivated Strategies for Learning Questionnaire. *Learning and Individual Differences.* doi:10.1016/j.lindif.2011.03.002.

Cury, A., Elliot, A., Sarrazin, P., Da Fonseca, D. & Rufo, M. (2002). The trichotomous achievement goal model and intrinsic motivation: a sequential mediational analysis. *Journal of Experimental Social Psychology*, 38, 473-481. http://dx.doi.org/10.1016/S0022-1031(02)00017-3

Deci, E. L. & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior.* New York: Plenum. http://dx.doi.org/10.1007/978-1-4899-2271-7

Deci, E. L. & Ryan, R. M. (2000). The "what" and "why" of goal pursuit: Human needs and the self-determination of behavior. *Psychological Inquiry,* 11, 227-268. http://dx.doi.org/10.1207/S15327965PLI1104_01

Deci, E. L. & Ryan, R. M. (2008). Self-Determination Theory: A macrotheory of human motivation, development, and health. *Canadian Psychology, 49*(3), 182-185.

Deci, E. L. & Ryan, R. M. (2008a). Facilitating optimal motivation and psychological well-being across life's domains. *Canadian Psychology, 49*(1), 14-23.

Deci, E. L. & Vansteenkiste, M. (2004). Self-Determination Theory and basic need satisfaction: Understanding human development in positive psychology. *Ricerche di Psicologia, 27*(3), 23-40.

Deci, E. L., Eghrari, H., Patrick, B. C. & Leone, D. R. (1994). Facilitating internalization: The self-determination perspective. *Journal of Personality,* 62, 119-142.

Elliot, A. J. & Harackiewicz, J. M. (1996). Approach and avoidance achievement goals and intrinsic motivation: A mediational analysis. *Journal of Personality and Social Psychology, 70*(3), 461-475. http://dx.doi.org/10.1037/0022-3514.70.3.461.

Elliot, A. J., Murayama, K. & Pekrun, R. (2011). A 3 x 2 Achievement Goal Model. *Journal of Educational Psychology, 103*(3), 632-648. http://dx.doi.org/10.1037/a0023952

Gagne, M. & Deci, E. L. (2014). The History of Self-Determination Theory in Psychology and Management. In M. Gagne (Ed.), *The Oxford Handbook of Work Engagement, Motivation, and Self-Determination Theory* (p. 1-9). New York: Oxford University Press.

Gillet, N., Vallerand, R. J. & Lafreniere, M.-A. K. (2012). Intrinsic and extrinsic school motivation as a function of age: the mediating role of autonomy support. *Social Psychology Education*, 15, 77-95.

Gottfried, A. E., Flemming, J. S. & Gottfried, A. W. (2001). Continuity of academic intrinsic motivation from childhood throughout late adolescence: A longitudinal study. *Journal of Educational Psychology*, *93*(1), 3-13. doi:10.1037//0022-0663.93.1.3

Halvari, H., Ulstad, S. O., Bagøien, T. E. & Skjesol, K. (2009). Autonomy support and its links to physical activity and competitive performance: mediations throughout motivation, competence, action orientation and harmonious passion, and moderator role of autonomy support by perceived competence. *Scandinavian Journal of Educational Research, 53*(6), 533-555. http://dx.doi.org/10.1080/00313830903302059

Harter, S. (1981). A new self-report scale of intrinsic versus extrinsic orientation in the classroom: Motivational and informational components. *Developmental Psychology*, *17*(3), 300-312.

Hu, L. & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1) 1-55. http://dx.doi.org/10.1080/10705519909540118

Jung, T. & Wickrama, K. A. (2008). An Introduction to Latent Class Growth Analysis and Growth Mixture Modeling. *Social and Personality Psychology Compass 2*(1), 302-317. doi:10.1111/j.1751-9004.2007.00054.x

Komarraju, M. & Nadler, D. (2013). Self-efficacy and academic achievement: Why do implicit beliefs, goals, and effort regulation matter? *Learning and Individual Differences*, 25, 67-72.

Kusurkar, R. A., Ten Cate, T. J., Vos, C. M., Westers, P. & Croiset, G. (2013). How motivation affects academic performance: a structural equation modelling analysis. *Advances in Health Sciences Education 18*(1), 57-69. doi 10.1007/s10459-012-9354-3

Lee, F. K., Sheldon, K. M. & Turban, D. B. (2003). Personality and the Goal-Striving Process: The Influence of Achievement Goal Patterns, Goal Level, and Mental Focus on Performance and Enjoyment. *Journal of Applied Psychology, 88*(2), 256-265.

Lepper, M. R., Corpus, J. H. & Iyengar, S. S. (2005). Intrinsic and extrinsic motivational orientation in the classroom: Age differences and academic correlates. *Journal of Educational Psychology*, *97*(2), 184-196. doi:10.1037/0022-0663.97.2.184

Lynch, D. J. (2006). Motivational factors, learning strategies and resource management as predictors of course grades. *College Student Journal*, *40*(2), 423-428.

Lynch, D. J. (2010). Motivational beliefs and learning strategies as predictors of academic performance in college physics. *College Student Journal*, *44*(4), 920-927.

Muthen, L. & Muthen, B. (1998–2012). *Mplus user guide. Seventh Edition.* Los Angeles: CA, Muthen & Muthen.

Nishimura, T. & Sakurai, S. (2017). Longitudinal changes in academic motivation in Japan: Self-determination theory and East Asian cultures. *Journal of Applied Developmental Psychology,* 48, 42-48. http://dx.doi.org/10.1016/j.appdev.2016.11.004

Ntoumanis, N., Barkoukis, V. & Thøgersen, E. C. (2009). Developmental trajectories of motivation in physical education: course, demographic differences and antecedents. *Journal of Educational Psychology*, 101, 717-728.

Nylund, K. L., Asparoutiov, T. & Muthen, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture m modeling: A Monte Carlo simulation study. *Structural Equation Modeling-A Multidisciplinary Journal, 14*(4), 535-569. doi:10.1080/10705510701575396

Otis, N., Grouzet, F. M. & Pelletier, L. G. (2005). Latent motivational change in a academic setting: A 3-year longitudinal study. *Journal of Educational Psychology*, *97*(2), 170-183. doi:10.1037/0022-0663.97.2.170

Pintrich, P. R. (1999). The role of motivation in promoting and sustaining self-regulated learning. *International Journal of Educational Research*, 31, 459-470.

Pintrich, P. R., Smith, D. A., Garcia, T. & McKeanchie, W. J. (1991). *A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ)*. Ann Arbor, MI: University of Michigan.

Ponterotto, J. G. & Ruckdeschel, D. (2007). An overview of coefficient alpha and a reliability matrix for estimating adequacy of internal consistency coefficients with psychological research measures. *Perceptual and Motor Skills*, 105, 997-1014.

Reeve, J. & Jang, H. (2006). What teachers say and do to support students' autonomy during a learning activity. *Journal of Educational Psychology*, 98, 209-218.

Ryan, R. M. & Conell, J. P. (1989). Perceived locus of causality and internalization: examining reasons for acting in two domains. *Journal of Personality and Social Psychology,* 57, 749-761. http://dx.doi.org/10.1037/0022-3514.57.5.749

Ryan, R. M. & Deci, E. L. (2002). Overview of Self-Determination Theory: An Organismic Dialectical Perspective. In E. L. Deci & R. M. Ryan, *Handbook of Self-Determination Research* (p. 3-33). Rochester NY: The University of Rochester Press.

Ryan, R. M. & Deci, E. L. (2017). *Self-Determination Theory. Basic psychological needs in motivation, development, and wellness*. New York: The Guilford Press.

Schermelleh-Engel, K., Moosbrugger, H. & Muller, H. (2003). Evaluating the fit of structure equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research*, *8*(2), 23-74.

Shang, R. A., Chen, Y. C. & Shen, L. (2005). Extrinsic versus intrinsic motivations for consumers to shop on-line. *Information & Management*, 42, 401-413.

Solberg, P. A. & Halvari, H. (2009). Perceived autonomy support, personal goal content, and emotional well-being among elite athletes: Mediating effects of reasons for goals. *Perceptual and Motor Skills*, 108, 721-743. http://dx.doi.org/10.2466/pms.108.3.721-743

Taylor, I. M., Ntoumanis, N., Standage, M. & Spray, C. M. (2010). Motivational predictors of physical education students' effort, exercise intentions, and leisure-time physical activity: A multilevel linear growth analysis. *Journal of Sport & Exercise Psychology*, 32, 99-120.

Ulstad, S. O., Halvari, H., Sørebø, Ø. & Deci, E. L. (2016). Motivation, learning strategies, and performance in physical education at secondary school. *Advances in Physical Education*, 6, 27-41. http://dx.doi.org/10.4236/ape.2016.61004

Utdanningsdirektoratet. (2015). *Curriculum for physical education.* Retrieved from: http://www.udir.no/kl06/KR01-03/Hele/.

Vlachopoulos, S. P. & Michailidou, S. (2006). Development and initial validation of a measure of autonomy, competence, and relatedness in exercise: The basic psychological needs in exercise scale. *Measurement in Physical Education and Exercise Science*, 10, 179-201.

White, R, W. (1959). Motivation reconsidered: The concept of competence. *Psychological Review, 66*(5), 297–333. doi:10.1037/h0040934

Wild, T. C., Kuiken, D. & Schopflocher, D. (1995). The role of absorption in experiential involvement. *Journal of Personality and Social Psychology*, *69*(3), 569-579. http://dx.doi.org/10.1037/0022-3514.69.3.569

Williams, G. C., Grow, V. M., Freedman, Z. R., Ryan, R. M. & Deci, E. L. (1996). Motivational predictors of weight loss and weight-loss maintenance. *Journal of Personality and Social Psychology*, *70*(1) 115–126. http://dx.doi.org/10.1037/0022-3514.70.1.115