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TEACHING STYLES IN PHYSICAL EDUCATION: THE EFFECTS ON PHYSICAL  
ACTIVITY LEVELS OF MIDDLE SCHOOL STUDENTS WITH DIFFERENT  
MOTIVATION TYPES

A Manuscript Style Thesis Submitted in Partial Fulfillment of the Requirements for the  
Degree of Master of Science in Exercise and Sport Science-Physical Education Teaching  
(Adapted Physical Education and Adventure Physical Education Emphasis)

Yongju Hwang

College of Science and Health Physical Education Teaching: Adapted Physical Education  
and Adventure Physical Education Emphasis

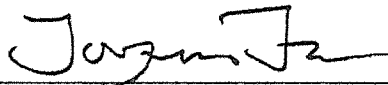
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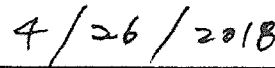
By Yongju Hwang

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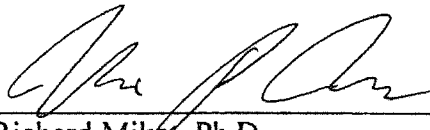
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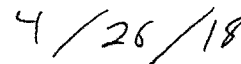
Jooyeon Jin, Ph.D.  
Thesis Committee Co-Chairperson



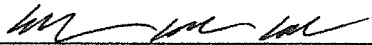
Date



Richard Mikat, Ph.D.  
Thesis Committee Co-Chairperson



Date



Matthew Maurer, Ph.D.  
Thesis Committee Member

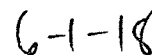


Date

Thesis accepted



Meredith Thomsen, Ph.D.  
Graduate Studies Director



Date

## ABSTRACT

Hwang, Y. Teaching styles in physical education: the effects on physical activity levels of middle school students with different motivation types. MS in Exercise and Sport Science-Physical Education Teaching, April 2018, 74pp. (J. Jin)

Self-determination theory (SDT) has been widely investigated to understand and change an individual's physical activity (PA) behavior in different settings (Deci & Ryan, 1985; 1991; 2000). The first purpose of this study was to examine if physical educators' teaching style influences student needs that affect student motivation, which in turn predict objectively measured student PA and MVPA levels (i.e., a serial mediator model). The second purpose was to explore moderating role of students' gender on those relationships. 313 students from three middle schools in Wisconsin completed Learning Climate Questionnaire modified from Williams and Deci (1996), Psychological Need Scale and Need Frustration Scale adopted from Chen et al. (2015), and Physical Education Questionnaire modified from (Aelterman et al., 2012) in a row to assess perceptions of autonomy-supportive teaching, experience of need satisfaction and need frustration, and motivational outcomes, respectively. Participants' PA and MVPA levels were recorded using a GT3X+ accelerometer (Actigraph, Pensacola, FL) for four consecutive PE lessons. It was found that although there was no gender effect on the relationships of SDT constructs, there was an indirect mediating effects of competence satisfaction and intrinsic motivation between autonomous teaching style and the students' objectively measured PA and MVPA levels. The results showed that PE teachers' autonomous teaching behavior is effective to promote students' objectively measured PA behavior during physical education lessons. Therefore, it is worth paying attention to how to provide autonomous teaching to students efficiently in the PE setting.

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## INTRODUCTION

Moderate-to-vigorous physical activity (MVPA) is important to develop and maintain a healthy lifestyle for adolescents. There have been many research efforts to show that participating in MVPA leads to a variety of health benefits for children and adolescents. For example, physically active students can obtain a positive physical self-concept, global self-esteem (Dishman et al., 2006), and higher academic results (Singh et al., 2012). International guidelines by the World Health Organization (WHO) recommend that from 5 to 17 year-old children should engage in 60 minutes of MVPA each day (World Health Organization, 2014). However, many children and adolescents still have insufficient MVPA to gain health-related benefits (Crawford, 2009; Hardy et al., 2010; Sallis, 2000; U.S. Department of Health and Human Services, 2000). To overcome this problem, many ideas, such as increasing MVPA time in physical education (PE), have been suggested and research-based approaches, including SPARK (i.e., a physical activity promoting curriculum), have been implemented.

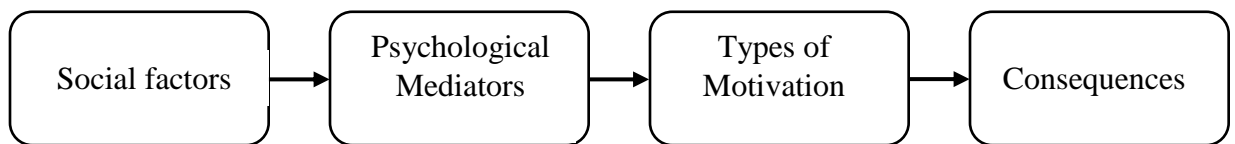
PE teachers may provide an opportunity for adolescents to engage in more MVPA and develop the necessary movement skills, knowledge and attitudes required for a lifetime physical activity (PA) habit during PE lessons (Hills et al., 2015). Nevertheless, many adolescents are not physically active during PE lessons (Biddle et al., 2004). It is therefore warranted to consider students' motivation as a modifiable factor to increase their MVPA levels in PE classes. For instance, Solmon (2015) demonstrated that students with strong PA motivations are more likely to enjoy and participate in PA in PE classes,

as well as outside of the classes (e.g., after school). In order to optimize students' motivation in PE, the motivational process must be thoroughly investigated and implemented in PE settings. Self-determination theory may guide the researcher on this purpose (Deci & Ryan, 2000).

Self-determination theory (SDT) is a comprehensive and powerful theoretical framework that explains an individual's motivational dynamics on human behavior, and it is based on three basic psychological needs (Deci & Ryan, 1991, 2000). These basic psychological needs affect students' self-determined motivation in a certain setting (e.g., PE classes), and students with self-determined motivation make decisions to actively engage in a behavior (e.g., PA). Specifically, when the needs for autonomy (i.e., experiencing a sense of volition when people decide about their participation), competence (i.e., experiencing a sense of success or achievement in their activity), and relatedness (i.e., experiencing a sense of connected and belonging in their social environment) are satisfied, psychological growth, self-determined motivation and well-being are promoted (Ryan & Deci, 2002).

SDT postulates different types of motivations that contribute to human behavior (Deci & Ryan, 2000). Within the SDT framework, motivation is conceptualized along with a self-determination continuum. At one end of the continuum we see intrinsic motivation, which is defined as a highly autonomous behavior. In intrinsic motivation, an individual chooses to engage in an activity for their own sake rather than for an external reason. An individual who is intrinsically motivated has inherent satisfaction and pleasure when he/she behaves favorably. At the middle of the continuum we find extrinsic motivation, which refers to activities performed as a means to an end and not for

its own sake (Deci & Ryan, 1985). Extrinsic motivation involves four levels of external regulations: external regulation (behaviors controlled by external forces, such as rewards, constraints, threat, or punishment); introjected regulation (behaviors in which individuals engage in activities to achieve approval or avoid internal pressures and feeling guilty); identified regulation (behaviors that are performed as valuable and important to an individual); and integrated regulation (behaviors that are performed with goals more focused on one's definition of self). Finally, at the far end of SDT-continuum we see amotivation, which is defined as the absence of motivation - both intrinsic and extrinsic. When individuals are amotivated, they have no reason to engage in activities and experience feelings of incompetence (Vallerand, Pelletier, Blais, Briere, Senecal, & Vallieres, 1992).



*Figure 1.* Motivational sequence adapted from Vallerand (1997, 2000)

SDT has been modified and revised over the years. In order to focus on the importance of a hierarchical structure of motivational processes, Vallerand (1997; 2000) outlined the different types of motivation and motivational consequences as shown in Figure 1. In this theoretical process, many different kinds of social factors play an imperative role in promoting an individual's motivation when his/her three innate

psychological needs are satisfied (Standage, Duda & Ntoumanis, 2005). Finally, different types of motivation affect three types of consequences: cognitive, affective, and behavioral (Vallerand, 1997, Vallerand & Losier, 1999).

Autonomy support of SDT asserts that while an individual with authority (e.g., a teacher) refrains from being pressuring or demanding, he/she considers the other's (e.g., a student's) perspective, understands how the other feels, and guarantees the other choice by providing relevant information and opportunities (Deci & Ryan, 1985). For instance, autonomy-supportive teachers attempt to develop, identify, and nurture student's perspective and inner motivational resources (Reeve, 2009). They offer meaningful choices (e.g., Prusak, Treasure, Darst & Pangrazi, 2004), create opportunities and encourages initiative (e.g., Reeve & Jang, 2006), and adopt student's interests (e.g., Ryan, 1982). Conversely, the controlling authority utilizes coercive or seductive technologies, which generally encompasses implicit or explicit rewards or punishments, to enforce others to behave in certain ways (Deci & Ryan, 1985). For example, controlling teachers pressure students to think, feel or behave in particular ways and dismiss student's viewpoints (Reeve, 2009). Controlling teaching is expressed in at least two different ways (Ryan, 1982; Soenens & Vansteenkiste, 2010). First, externally controlling teaching involves the use of overtly observable controlling tactics such as punishments, pressuring, rewards, yelling and explicitly controlling languages (e.g., Assor, Kaplan, Kanat, Maymon & Roth, 2005; Reeve & Jang, 2006; Vansteenkiste, Simons, Lens, Sheldon & Deci, 2004). Second, internal control of teaching involves the use of less directly observable tactics such as teachers appealing to learner's feelings of guilt, shame, anxiety and self-worth (Vansteenkiste, Dochy & Goossens, 2012).

According to SDT, the consequences of autonomy-supportive and controlling teaching on student's behavior can be represented through the process of need satisfaction and need frustration. Specifically, while the satisfaction of the three needs for autonomy, competence and relatedness is hypothesized to promote high-quality motivation, the frustration of the three needs for autonomy, competence and relatedness is assumed to face maladjustment (Deci & Ryan, 2000; Vansteenkiste & Ryan, 2013).

Although there are many studies that used SDT to explain adolescents' PA behavior, there are no known studies that assess if students' needs and motivation mediate the relationship between teaching style and objectively measured PA based on the entire SDT constructs. In addition, it is unknown if this mechanism works differently by gender. Therefore, the primary purpose of this study was to investigate if students' needs and motivations mediate the relationship between teaching styles and students' objectively measured PA levels. Based on a previous study (Zhang, Solmon, Kosma, Carson, & Gu, 2011), it was hypothesized that teaching style will influence student needs that will affect student motivation, which in turn predict objectively measured students' PA levels (a serial mediator model as shown in Figure 1). The secondary purpose of this study was to explore the moderating role of students' gender on those relationships. It was hypothesized that the mediation effect would be stronger for boys than girls based on a previous literature (Alterman et al., 2012; Fairclough & Stratton, 2005; How & John, 2016).

## **METHODS**

### **Participants**

Three hundred and thirteen students (158 boys and 155 girls; mean age 13.53 years) from 17 classes from three middle schools in northwest Wisconsin were recruited through five certified physical education teachers after permission was given from each school principal. Informed consent was obtained from the teachers, students and students' parents prior to primary data collection.

### **Instrument**

Two different types of instruments were used: (a) paper and pencil questionnaires to measure SDT constructs and (b) accelerometers to measure PA levels.

### **Questionnaires**

Three questionnaires were used to gather data for (a) perceived autonomy supportive and controlling teaching, (b) experience of need satisfaction and need frustration, and (c) motivational outcomes of the study participants.

### **Perceived Autonomy-Supportive and Controlling Teaching**

The 6-item version of Learning Climate Questionnaire (LCQ; Williams & Deci, 1996) was used to assess perceptions of autonomy-supportive teaching. This Autonomous scale has been used successfully in previous studies to assess autonomy-supportive teaching for secondary-level (Jang et al., 2009; Cheon et al., 2014; Cheon et al., 2015) and college-level students (Black & Deci, 2000). An example item is "My PE teacher listens to how I would like to do things." Cheon et al. (2012) reported internal consistency of .83, .88, and .93 after measuring three times respectively. In addition,

Cheon et al. (2015) reported internal consistency of .94, .96, .97, and .97 after measuring three times respectively. In the current study, Cronbach's alpha of this scale was .86. To assess perceptions of controlling teaching, the 4-item version of Controlling Teacher Scale (CTS; Jang et al., 2009) was used. An example item is "My PE teacher puts a lot of pressure on me." Cheon et al. (2012) and reported internal consistency of .74, .80, and .84 after measuring three times respectively. In addition, Cheon et al. (2014) reported internal consistency of .81, .86, .97, and .90 after measuring three times respectively. In the current study, Cronbach's alpha of this scale was .80. This Autonomous scale has also been used successfully in previous studies for K-12 students (Cheon & Reeve, 2013; Jang et al., 2009; Cheon et al., 2014). All items in this section were scored with a 7-point Likert scale (i.e., 1-strongly disagree to 7 -strongly agree).

### **Experiences of Need Satisfaction and Need Frustration**

Participants' experience of need satisfaction (satisfying autonomy, competence, and relatedness) and need frustration (dissatisfying autonomy, competence, and relatedness) were measured with the Basic Psychological Need Scale and Need Frustration Scale (BPNSNP; Chen et al., 2015). This recently developed and validated 24-item scale for adolescents included eight items, four of which addressed need satisfaction and the other four, need frustration. An example from this instrument is "I feel free to choose which activities I do." Items were rated on a 5-point Likert scale from 1 (not true for me) to 5 (very true for me). BPNSNP has previously been used in the context of PE (Haerens et al., 2015) and a recent study (De Meyer et al., 2016) reported very good reliability of BPNSNP (Cronbach alpha=.90 for need satisfaction and .81 for need frustration). Meyer also found that investigated students' (age=15 to 22 years old)

experience of need satisfaction and need frustration in school PE. In the current study, Cronbach's alphas for the autonomy satisfaction, relatedness satisfaction, competence satisfaction, autonomy frustration, relatedness frustration, and competence frustration were .82, .82, .85, .76, .80, .83, respectively.

### **Motivational Outcomes**

Students' intrinsic motivation, extrinsic motivation (external regulation, introjected regulation, identified regulation, and integrated regulation), and amotivation toward PE class were assessed with the 25-item Behavioral Regulations in Physical Education Questionnaire (BRPEQ; Aelterman et al., 2012). An example item from this questionnaire is "I put effort in this PE class because I have to prove myself". Items were rated on a 5-point Likert scale from 1 (not true for me) to 5 (very true for me). The stem was followed by items reflecting autonomous motivation, controlled motivation, and Amotivation. De Meyer et al. (2016) reported internal consistency of .92 for intrinsic motivation, .69 for extrinsic motivation, and .79 for amotivation, respectively. In the current study, Cronbach's alphas for the intrinsic motivation, identified regulation, Introjected regulation, External regulation, and Amotivation were .92, .88, .84, .82, .93, respectively.

### **Accelerometers**

Students' PA levels were assessed using ActiGraph GT3X+ accelerometers (Actigraph, Pensacola, FL). The GT3X+ is a triaxial accelerometer using digital filter that limit the sampling to the frequency range of 0.25 to 2.5 Hz to detect normal human movement. This accelerometer has demonstrated strong validity and reliability in measuring PA levels of adolescents in many studies (Aelterman et al., 2012; Reilly et al.,

2008; Trost, Way & Okely, 2006). For instance, researchers revealed its excellent reliability and validity to measure PA levels while walking at normal gait speeds (McMinn, Acharya, Rowe, Gray, & Allan, 2013; Santos-Lozano et al., 2012), step-count at fast gait speeds (Kelly et al., 2013; Rowlands, Stone, & Eston, 2007; Santos-Lozano et al., 2012), and MVPA of children (Borghese et al., 2016).

### **Pilot Study**

Prior to the main data collection, two pilot studies were conducted to ensure the content of the questionnaires were an appropriate fit to middle school students and to check for reliability. The first pilot study included 23 students of both genders from a convenience sample selected from a class of Wisconsin middle school students who did not participate in this paper's primary study. Permission was obtained from the school principal and informed consent was gathered from the students and their parents before collecting data. The results revealed that autonomy satisfaction, autonomy frustration, related frustration, and external regulation did not demonstrate acceptable levels of reliability ( $\alpha \geq 0.70$ ; Nunnally & Bernstein, 1994). Cronbach's alpha of these variables was .05, .68, .15, .51, respectively. Based on feedback and Cronbach's alpha coefficients, directions, and structures of the questionnaires were modified. For the second pilot study, eighteen students of both genders were selected from a different set of Wisconsin middle school students who also were not a part of this paper's primary study. As with the first pilot study, permission was obtained from the school principal and informed consent was gathered from the students and their parents before collecting data. The results of the second pilot study revealed that Cronbach's alpha of the four variables increased so that all variables demonstrated acceptable levels of reliability ( $\alpha \geq 0.70$ ; Nunnally &

Bernstein, 1994).

### **Procedures**

Before data collection, teachers were asked not to deviate or modify their planned lessons during the course of this study. Because each school teacher already had their own planned curriculum, lesson contents at various locations could not be altered. Data was collected in two waves. In the first wave, students completed LCQ to assess perceptions of autonomy-supportive teaching. During completing the questionnaires, the researcher responded some students' questions. In each classroom, there were two or three students who missed the questionnaire items. For those students, the researcher immediately asked them again to complete the questionnaire without the missing. In the second wave, students completed BPNSNP and BRPEQ questionnaires. GT3X+ accelerometer instructions and orientation were also provided in the second wave. Students in each classroom wore a GT3X+ and their PA levels were monitored for four consecutive PE lessons based on a recommendation of Frémeaux (2011). Prior to each class, the GT3X+ accelerometers were randomly assign to each participant to avoid potential systematic errors in the devices. The researcher was present during each PE class to record information and to ensure that all established procedures were followed. After students' PA data were collected via GT3X+ accelerometers, data was processed using Altigraph software. After that, data were coded and entered into Microsoft Excel and SPSS for final statistical examinations. All data were double-checked and screened for errors prior to analyses.

### **Analysis**

Prior to conducting the primary analysis, preliminary statistical analyses were conducted to estimate internal consistency and to generate descriptive statistics across all study variables using SPSS 23.0 (IBM, 2016). To ensure adequate measures of the entire SDT model, a confirmatory factor analysis using a maximum likelihood estimator was performed. A Chi-Square/Degrees of Freedom Ratio ( $\chi^2/df$ ), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA) were used. A  $\chi^2/df$  of less than three, a CFI of greater than 0.90, and a RMSEA of less than .08 were used as fitness criteria (Browne & Cudeck, 1993; Hu & Bentler, 1999; West, Finch, & Curran, 1995).

Structural equation modeling (SEM) with maximum likelihood estimation was conducted to test the primary hypothesis of this paper. To test the utility of the entire SDT model, PA used as the outcome variable and defined as the percentage of time spent in light-to-vigorous physical activity in a PE class. In addition, MVPA was included as an outcome variable and was defined as the percentage of time spent in moderate-to-vigorous physical activity in a PE class. PA and MVPA were calculated in using the Freedson Children (2005) cut point. In the current study, percentage of time spent in PA and MVPA for the outcome value was utilized. This was because each class varied in length. The medication effect based on the serial mediation model was also examined using SEM as it provided tests of significance for direct, indirect and total effects. To determine the moderation effect of gender (second hypothesis of this paper), separate multiple regressions with interaction terms were conducted using PROCESS, a regression-based computational procedure program designed for moderation and mediation analyses in SPSS. For all SEM analyses, Mplus 8.0 (Muthen & Muthen, 2017)

was used.

## RESULTS

### Preliminary Analyses

A majority of students (79.5%) participated in PA over two hours each day, and 89.2% of students reported that they were in good general health. Average MVPA was 33.33% and average PA was 77.80%. Descriptive statistics and internal consistencies (Cronbach's alpha) of SDT and PA variables are presented in Table 1. All the variables demonstrated acceptable levels of reliability ( $\alpha \geq 0.70$ ; Nunnally & Bernstein, 1994).

Table 1  
*Cronbach's Alphas, Means, and Standard Deviations for All Variables*

Variable	$\alpha$	M	SD	Skewness	Kurtosis
Autonomy satisfaction	.82	4.02	.78	-1.04	1.30
Autonomy frustration	.76	2.50	.87	.65	.10
Relatedness satisfaction	.82	4.23	7.37	-1.50	2.82
Relatedness frustration	.80	1.90	8.75	1.23	1.01
Competence satisfaction	.85	4.04	7.20	-.78	.87
Competence frustration	.83	2.63	.98	.45	-.51
External regulation	.82	1.99	.91	1.07	.84
Introjected regulation	.84	2.27	1.08	.65	-.57
Identified regulation	.88	3.11	1.08	-.07	-.68
Intrinsic motivation	.92	3.61	1.14	-.72	-.31
Amotivation	.93	1.68	.98	1.54	1.58
Autonomous teaching behavior	.86	4.48	1.42	-.18	-.70
Controlling teaching behavior	.80	2.17	1.24	1.50	2.19
% in MVPA	—	33.33%	11.14%		
% in PA	—	77.80%	9.70%		

*Note. M=mean; SD=standard deviation; % in MVPA= the amount of time students spends in moderate-to-vigorous physical activity during a PE class; % in PA=the amount of time students spends in physical activity during a PE class.*

Correlations of constructs in an autonomous stream of SDT are presented in Table 2, in which MVPA were correlated with autonomy satisfaction, competence satisfaction, identified regulation, and intrinsic motivation. PA was correlated with identified regulation, intrinsic motivation, and MVPA. Also, correlations of constructs in a controlling stream of SDT are presented in Table 3. It revealed that MVPA and PA were correlated with competence frustration.

Although CFI value was a bit low, the other model fit indices of the entire SDT measurement model ( $\chi^2/df=2.197$ , RMSEA=.062, CFI=.82) and autonomous SDT measurement model ( $\chi^2/df=2.786$ , RMSEA=.076, CFI=.88) appeared fair. Controlling SDT measurement model ( $\chi^2/df=2.092$ , RMSEA=.059; CFI=.91) appeared good including CFI. Standardized factor loadings for the SDT constructs on each of its indicators were all positive and significant, exceeding the minimum of .50 as recommended by Ford, MacCallum, and Tait (1986). In addition, all the variables met the normal distribution assumption.

To examine the potential influence of the contents and location were examined, but it was reveal that they did not have a significant effect. Therefore, we did not control these variables for SEM analysis.

Table 2  
*Bivariate relationships of SDT constructs in an autonomous stream*

	1	2	3	4	5	6	7	8
1 AS								

2	RS	.49**							
3	CS	.30**	.34**						
4	IDR	.18**	.15**	.27**					
5	INM	.22**	.26**	.35**	.62**				
6	ATB	.31	.27**	.33**	.46**	.42**			
7	CTB	-.10	-.11*	-.11	-.07	-.18**	-.35**		
8	MVPA	-.13*	-.09	.14*	.25**	.27**	.024	.08	
9	PA	-.09	-.07	.09	.25**	.30**	.068	.033	.67**

Note. AS=autonomy satisfaction; RS=relatedness satisfaction; CS=competence satisfaction; IDR=identified regulation; INM=intrinsic motivation; ATB=autonomous teaching behavior; CTB=controlling teaching behavior; MVPA= moderate-to-vigorous physical activity; PA= physical activity; \*= $p < 0.05$ ; \*\*= $p < 0.01$ ; \*\*\*= $p < 0.001$

Table 3  
Bivariate relationships of SDT constructs in a controlling stream

		1	2	3	4	5	6	7	8	9
1	AF									
2	RF	.33**								
3	CF	.34**	.53**							
4	EXR	.32**	.33**	.40**						
5	INR	.15**	.21**	.29**	.51**					
6	AM	.33**	.34**	.27**	.36**	.11				
7	ATB	-.16**	-.16**	-.21**	-.07	.09	-.16**			
8	CTB	.27**	.27**	.22**	.36**	.23**	.37**	-.35**		
9	MVPA	-.01	-.10	-.23**	-.03	.03	-.09	.02	.08	
10	PA	.09	-.07	-.17**	-.05	.03	-.09	.07	.03	.67**

Note 1. AF=autonomy frustration; RF=relatedness frustration; CF=competence frustration; EXR= external regulation; INR=introjected regulation; AM= amotivation; ATB=autonomous teaching behavior; CTB=controlling teaching behavior; MVPA= moderate-to-vigorous physical activity; PA= physical activity; \*= $p < 0.05$ ; \*\*= $p < 0.01$ ; \*\*\*= $p < 0.001$

## Structural Equation Modelling (SEM)

### Entire Model

The entire SDT model explained that 21% of the variance in INM, 16% of the variance in IDR, 19% of the variance in INR, 24% of the variance in EXR, 11% of the variance in AM, 11% of the variance in PA, and 8% of the variance in MVPA. ATB significantly predicted AS ( $\beta=.38, p<.001$ ), RS ( $\beta=.34, p<.001$ ), and CS ( $\beta=.45, p<.001$ ).

ATB had a positive effect on all three constructs regarding an individual's needs.

Although AS, RS, and CS were the predictors of INM, only CS significantly predicted INM ( $\beta=.40, p<.001$ ) but, AS and RS did not. CS had a positive effect on a construct regarding INM.

Although AS, RS, and CS were the predictors of IDR, only CS significantly predicted IDR ( $\beta=.35, p<.001$ ) but, AS and RS did not. CS had a positive effect on a construct regarding IDR. Although INM and IDR were the predictors of PA,

only INM significantly predicted PA ( $\beta=.28, p<.001$ ) but, IDR did not. INM had a positive effect on a construct regarding PA. INM significantly predicted MVPA ( $\beta=.20, p<.01$ ). INM had a positive effect on a construct regarding MVPA. IDR significantly predicted MVPA ( $\beta=.16, p<.05$ ). IDR had a positive effect on a construct regarding MVPA.

CTB significantly predicted AF ( $\beta=-.30, p<.001$ ), RF ( $\beta=-.21, p<.001$ ), and CF ( $\beta=-.32, p<.001$ ). CTB had a negative effect on all three constructs regarding an individual's needs. AF, RF, and CF were the predictors of INR. AF and RF significantly predicted INR ( $\beta=.31, p<.001$ ), ( $\beta=.27, p<.001$ ), respectively but, CF did not. AF and RF had a positive effect on a construct regarding INR. AF, RF, and CF significantly

predicted EXR ( $\beta=.24, p<.001$ ), ( $\beta=.20, p<.001$ ), ( $\beta=.33, p<.001$ ), respectively. All three constructs had a positive effect on a construct regarding EXR. Although AF, RF, and CF were the predictors of AM, only CF significantly predicted AM ( $\beta=.30, p<.001$ ) but, AF and RF did not. CF had a positive effect on a construct regarding AM.

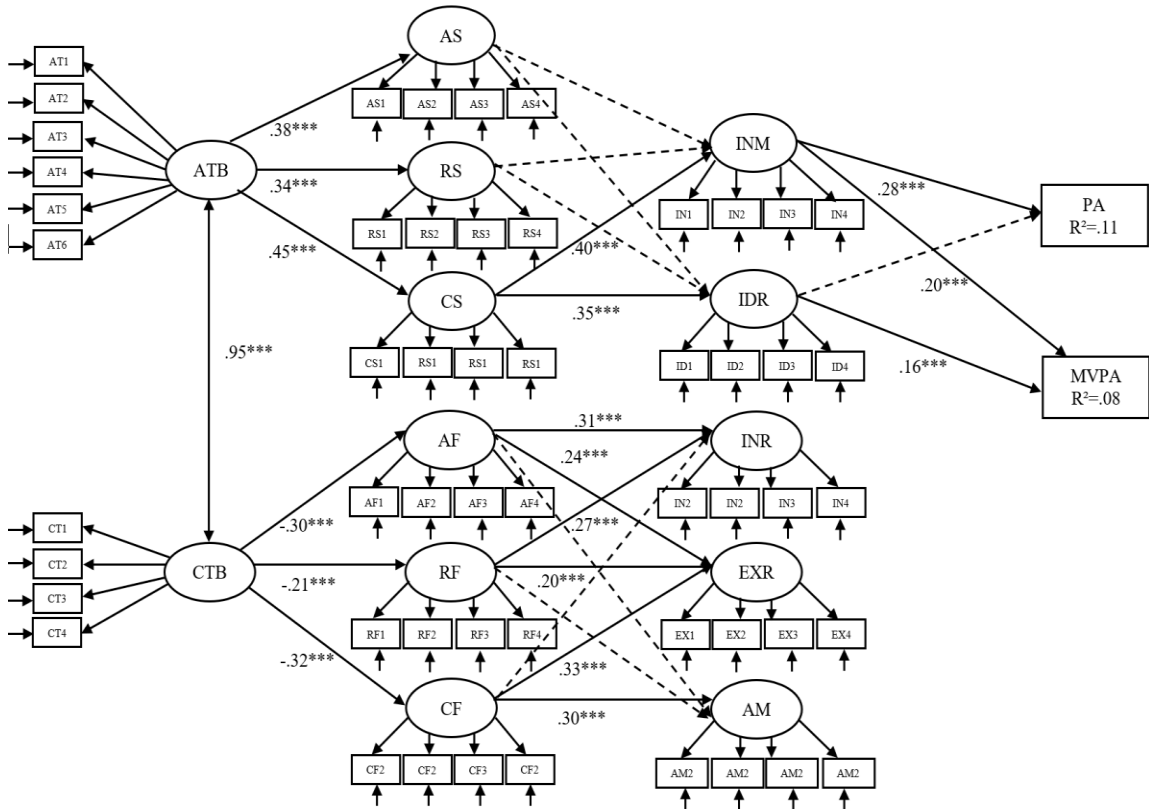


Figure 2. Entire structural equation model of SDT

Note. AT and ATB=autonomous teaching behavior; CT and CTB=controlling teaching behavior; AS=autonomy satisfaction; RS=relatedness satisfaction; CS=competence satisfaction; AF=autonomy frustration; RF=relatedness frustration; CF=competence frustration; IDR=identified regulation; INM=intrinsic motivation; INR=introjected regulation; EXR= external regulation; AM= amotivation; PA= physical activity; MVPA= moderate-to-vigorous physical activity; \*= $p<0.05$ ; \*\*= $p<0.01$ ; \*\*\*= $p<0.001$

### Autonomous Part of Model

The autonomous part of model explained that 18.4% of the variance in INM and 12.6% of the variance in IDR. ATB significantly predicted AS ( $\beta=.43, p<.001$ ), RS

( $\beta=.38, p<.001$ ), and CS ( $\beta=.44, p<.001$ ). ATB had a positive effect on all three constructs regarding an individual's needs. Although AS, RS, and CS were the predictors of INM, only CS significantly predicted INM ( $\beta=.36, p<.001$ ) but, AS and RS did not. CS had a positive effect on a construct regarding INM. Although AS, RS, and CS were the predictors of IDR, only CS significantly predicted IDR ( $\beta=.30, p<.001$ ) but, AS and RS did not. CS had a positive effect on a construct regarding IDR.

### **Controlling Part of Model**

The controlling part of model explained that 9% of the variance in INR, 20% of the variance in EXR, and 18% of the variance in AM. CTB significantly predicted AF ( $\beta=-.25, p<.001$ ), RF ( $\beta=-.17, p<.001$ ), and CF ( $\beta=-.29, p<.001$ ). CTB had a negative effect on all three constructs regarding an individual's needs. Although AF, RF, and CF were the predictors of INR, only CF significantly predicted INR ( $\beta=.28, p<.001$ ) but, AF and RF did not. CF had a positive effect on a construct regarding INR. AF, RF, and CF significantly predicted EXR ( $\beta=.23, p<.001$ ), ( $\beta=.20, p<.001$ ), ( $\beta=.31, p<.001$ ), respectively. All three constructs had a positive effect on a construct regarding EXR. AF and CF significantly predicted AM ( $\beta=.30, p<.001$ ) and ( $\beta=.27, p<.001$ ), respectively. AF and CF had a positive effect on a construct regarding AM.

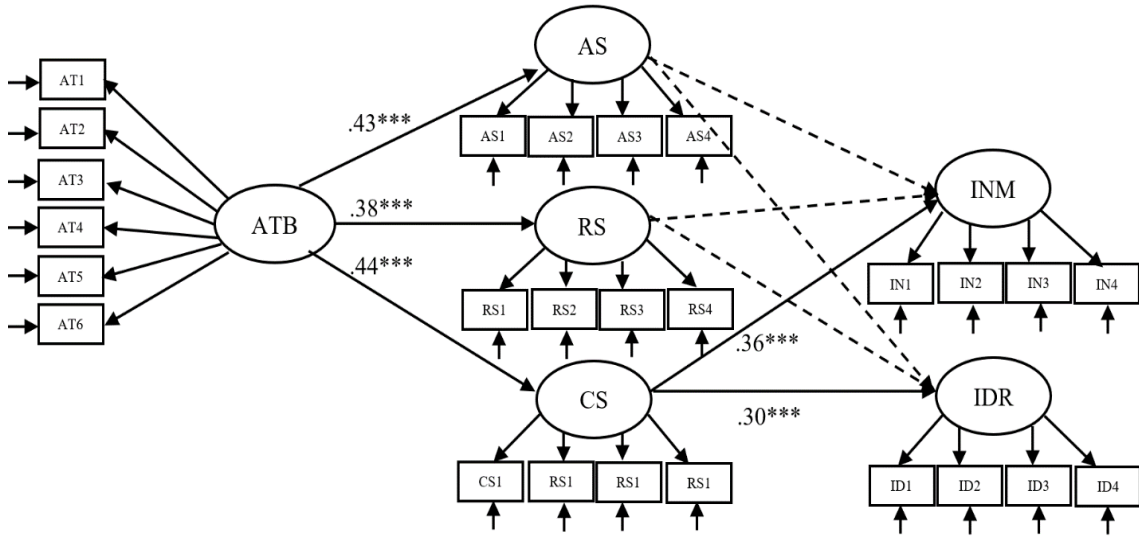


Figure 3. Structural equation model of autonomous part of SDT

Note. AT and ATB=autonomous teaching behavior; AS=autonomy satisfaction; RS=relatedness satisfaction; CS=competence satisfaction; INM=intrinsic motivation; IDR=identified regulation; INM=intrinsic motivation; \*= $p < 0.05$ ; \*\*= $p < 0.01$ ; \*\*\*= $p < 0.001$

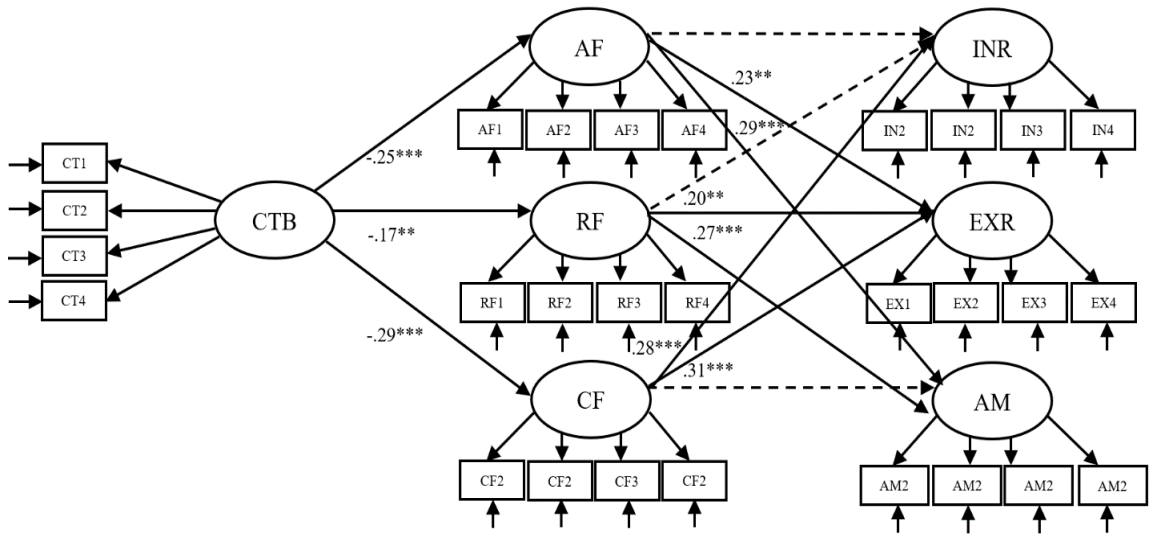


Figure 4. Structural equation model of controlling part of SDT

Note. CT and CTB=controlling teaching behavior; AF=autonomy frustration; RF=relatedness frustration; CF=competence frustration; INR=introjected regulation; EXR= external regulation; AM= amotivation; PA= physical activity; MVPA= moderate-to-vigorous physical activity; \*= $p < 0.05$ ; \*\*= $p < 0.01$ ; \*\*\*= $p < 0.001$

## **DISCUSSION**

The main purpose of this study was to investigate if students' needs and motivations mediate the relationship between teaching styles and students' objectively measured PA levels. The result showed the teaching style as a social factor influences students' three different psychological needs that affect students' different types of motivation which in turn impact students' PA. However, the utility of the entire SDT model was somewhat limited, particularly in terms of predicting PA ( $R^2 = 11\%$ ) and MVPA ( $R^2 = 8\%$ ).

### **Autonomy Teaching Behavior to Students' PA Behavior**

The current study found that students' three different psychological needs were supported by their teacher's autonomous teaching style. These results are closely aligned with previous studies (Cheon & reeve, 2015; Cheon et al, 2015; Haerens at al., 2015; How & John, 2016; Zhang et al., 2011; De Meyer, 2016). Previous research showed that students' autonomy, relatedness, and competence help to predict intrinsic motivation (Decy & Ryan, 1985; Ntoumanis, 2005; Standage et al., 2005, 2006) and autonomous motivation (Haerens at al., 2015). This study; however, showed that only competence need satisfaction predicted the intrinsic motivation and identified regulation. Nonetheless, this finding is in harmony with many studies demonstrating that competence need satisfaction is the strongest factor in predicting autonomous motivation, compared to autonomous need satisfaction and relatedness need satisfaction in PE settings (e.g., Dupont et al., 2009; Ntoumanis, 2001; Standage, Duda, & Ntoumanis 2006). A potential

reason of this limited relationship is that students have had different experiences in previous PA settings (Ntoumanis, 2001). The results of this study suggest that it is crucial to support students' three basic needs to foster their autonomous motivation (Standage et al., 2005, Zhang et al., 2011).

In terms of predicting PA, students' intrinsic motivation and identified regulation significantly predicted their objectively measured PA and MVPA levels. This finding is supported by many previous research findings. For example, there was the positive relationship between students' autonomous motivation and their cardiorespiratory fitness (Shen, McCaughy, Martin, & Fahlman, 2009), PA measured by pedometers (Lonsdale et al. 2009; Vierling, Standage, & Treasure, 2007), PA measured by accelerometer (Alterman et al., 2012), PA measured by heart rates (Jaakkola et al., 2008), and PA measured by self-reported measurement (Yli-Piipari et al., 2009).

Although, except the controlling teaching behavior path and objectively measured students' outcome, PE teachers' autonomous teaching style predicted students' three different psychological needs, but only competence satisfaction variable predicted students' intrinsic motivation and identified regulation. This result is consistent with the previous research (Standage et al., 2005, 2006), but the  $R^2$  value of the model was decreased by about 5%. These results suggest that to examine the effects of teachers' autonomous teaching style on students' motivation more effectively, researchers need to consider other variables within the SDT model.

### **Controlling Teaching Behavior to Students' PA Behavior**

This study found that teacher's controlling teaching style had a significantly negative association with psychological needs (i.e., autonomy, relatedness, competence

frustrations). These results aligned closely with previous literature (e.g., De Meyer et al., 2016; Haerens et al., 2015). With an expectation, there was the significant predictive utility of the needs on the motivations and this finding is supported by a previous study (Haerens et al., 2015). The current study showing that students' three different need frustration predicted the introjected regulation and external regulation. This is because, students' experience of need frustration makes them participate in PE classes only to meet internal or external demands. The results also showed that only competence frustration significantly predicted amotivation. This is because, in line with the results of autonomy teaching behavior to students' PA behavior, competence need frustration strongly predicts students' motivation in the entire SDT model. In other words, students' skill levels or capabilities to perform physical activity tasks in the PE lesson is a more important factor than the feeling of pressure and a relationship with the PE teacher.

There was no association between controlled motivation and objectively assessed PA and MVPA while Standage et al (2003) revealed that there was a negative relationship between controlled motivation and PA levels with self-reported measurement. Similar findings were observed in different contexts, such as PE (Alterman et al., 2012), exercise (e.g., Standage et al., 2008), and sport (e.g., Pelletier, Fortier, Vallerand, & Brière, 2001). This non-significant predictive power of the motivations on PA is probably due to two potential causes. Firstly, since teaching styles were not fully controlled in this research, the teachers might incorporate both controlling teaching and autonomy teaching styles simultaneously in their class (De Meyer et al., 2016) resulting in student bias. Secondly, students with controlling motivation or amotivation might choose their PA behavior in their daily life or leisure time – rather than in a PE class

setting. This can be mitigated to a degree by the adoption of an appropriate direction behavior management plan during PE lessons (Alterman et al., 2012).

In terms of predicting motivation, the controlling teaching behavior path showed little bit different results without teaching behavior path and students' outcome variables. In line with the entire model, teacher's controlling teaching style significantly predicted students' three different psychological needs in a negative direction. However, students' autonomy frustration predicted external regulation and amotivation, students' relatedness frustration predicted external regulation and amotivation, and students' competence frustration predicted introjected regulation and external regulation. Also, the R square value of the model decreased except for external regulation. Specifically, 1% of the variance decreased in introjected regulation and 0.7% of the variance decreased in amotivation while 0.4% of the variance increased in external regulation. These results indicated that to examine the effects of teachers controlling teaching style on students' motivation more efficiently, we need to consider other variables in the entire SDT model.

### **Gender Effect**

There was no gender effect on the relationships between SDT constructs. This was an unexpected finding. Since variations on lesson content were not fully controlled in this research, each PE teacher was free to implement a lesson designed to maximize students' PA. This was typically accomplished by choosing a activities that students enjoyed (e.g. basketball, floor hockey, tennis, badminton, soccer, tee-ball, etc.). Also, unrecorded contextual factors, such as class size, organizational strategies, teaching models, and available space may have contributed to this result.

### **Mediating Effect**

There were indirect mediating effects of competence satisfaction and intrinsic motivation between autonomous teaching style and the students' objectively measured PA and MVPA levels. This finding was in agreement with Vallerand (1997; 2000)'s hierarchical structure of motivational processes which demonstrated positive relationships between teaching style and students' needs, students' motivation, and physical activity participations. Therefore, to foster students' physical activity levels in the PE class, PE teachers need to promote student' intrinsic motivation and identified regulation by meeting their psychological needs using an autonomous teaching style. The present study also investigated mediating effects without the controlling teaching behavior path, which resulted in a 3% decrease of the  $R^2$  value. This finding shows that, although controlling teaching behavior did not influence students' outcomes, it has a role on the entire model. In other words, including the controlling teaching behavior path into the entire model allows for the interpretation that autonomous teaching behavior could impact students' PA and MVPA levels.

### **Limitations**

The current study was conducted in 17 classes from three middle schools in the Northwest region of Wisconsin for Convenience. Because the sample is not chosen at random, generalizability of this study may be limited. Also, students' PA levels were monitored for four consecutive PE lessons - which lasted for two to three weeks. Future researchers may wish to increase the monitoring time to get more representative PA data. Further, only five teachers participated in this study. In order to collect more meaningful and more generalizable data, more teachers need to be examined. Finally, the SDT related

data in the current study were all based on student self-reports. Students' perception of teaching style was likely to be regarded differently for each student. Thus, this limitation should be taken into account when generalizing the results to practice.

### **Implication and Future Directions**

The present study examined the hierarchical model of motivation (Vallerand, 1997, 2000; Ntoumanis, 2001) on PA levels using an objective measurement. The result revealed that in the school PE context, teacher's autonomy teaching style has a positive effect on student's PA and MVPA levels (Alterman et al., 2012; How & John, 2016; Zhang, Solmon, Kosma, Carson, & Gu, 2011). In future studies, it is recommended that the data be collected for longer periods of time and in more schools, over a wider geographic and demographic area. It is also recommended that data be collected using objective criteria such as a multi-informant (teacher, observer, student) perspective to gain additional insights. finally, it is recommended that future research focus on the impact of social factors on students' PA and MVPA levels outside of PE classes.

## **CONCLUSION**

There are many studies that used SDT to understand and explain adolescents' PA behavior. In line with previous search, this study investigated if students' needs and motivation mediate the relationship between teaching style and objectively measured PA as SDT proposes. The present studies found that physical education teachers' autonomous teaching behavior is effective to promote students' objectively measured PA and MVPA levels during physical education lessons. Also, the findings of this study highlight the importance of the students' needs and motivation. Based on the results of current study, it is worth paying attention to how to provide autonomous teaching to students efficiently in the PE setting.

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APPENDIX A  
STUDENT ASSENT AND PARENTAL CONSENT FORM

## Informed Assent Form for Students

**Project Title:** Applying Self-Determination Theory to Predict Moderate to Vigorous Physical Activity in Middle School Physical Education Lessons

**Principal Investigator:** Yongju Hwang

**Major Advisor:** Jooyeon Jin, Ph.D. & Richard Mikat, Ph.D.

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We are asking you whether you want to be in a research study. Research is a way to test new ideas and learn new things. You do not have to be in the study if you do not want to. You can say Yes or No. Even if you say yes now, you can change your mind later.

Ask questions if there is something that you do not understand. After all of your questions have been answered, you can decide if you want to be in this study or not.

This study is about how Self-Determination Theory works to explain your physical activity behavior in a physical education class. We are asking you if you want to be in this study because you are participating in a middle school physical education class in Wisconsin or Minnesota.

If you take part in this study, we will ask you to do a short survey and to wear a small activity monitor (accelerometer) on your waist. The monitor will tell us how much you are active during a physical education class.

Some things that might happen to you if you are in this study are wearing the activity monitor that may be uncomfortable to do activity during your physical education class.

Some good things might happen to you if you are in this study include that this research will be helpful to make your physical education class to be more fun and meaningful. We might also find out things that help other adolescents in the future.

We will write a report when the study is over, but we will not use your name in the report. If you want to be in the study, sign your name on the line below.

Participant's ID code: \_\_\_\_\_ (completed by researcher)

Participant's Name (printed):  
\_\_\_\_\_

\_\_\_\_\_

(Signature of Participant)

(Date)

\_\_\_\_\_

(Signature of Person Obtaining Assent)

(Date)

## **Informed Consent Form for Parents**

**Project Title:** Applying Self-Determination Theory to Predict Moderate to Vigorous Physical Activity in Middle School Physical Education Lessons

**Principal Investigator:** Yongju Hwang

**Major Advisor:** Jooyeon Jin, Ph.D. & Richard Mikat, Ph.D.

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### **1. WHAT IS THE PURPOSE OF THIS FORM?**

This form contains information you will need to help you decide whether to be in this study or not. Please read the form carefully and ask the researcher questions about anything that is not clear.

### **2. WHY IS THIS STUDY BEING DONE?**

The purpose of this research is to examine capability of Self-Determination Theory to explain adolescents' physical activity behavior in a middle school physical education class. This study is conducted by Yongju Hwang for the completion of his thesis. Up to 300 middle school students may be invited to take part in this study.

### **3. WHY IS MY CHILD BEING INVITED TO TAKE PART IN THIS STUDY?**

Your child is being invited to take part in this study because your child is studying at a middle school in Wisconsin or Minnesota.

### **4. WHAT WILL HAPPEN IF MY CHILD TAKES PART IN THIS RESEARCH STUDY?**

The researcher will visit your child's school and meet with him/her five times based on the following schedule chart.

\* Data collection schedule chart

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Visit 1	a. Explaining current project and collecting consent and assent forms b. Student survey administration c. An activity monitor orientation for students
Visit 2, 3, 4, & 5	a. Collecting students' physical activity by using an accelerometer

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During the first visit, the researcher will obtain a study assent document from your child and collect consent form that has your signature on it. If you and your child agree to participate in this project, a short survey will be given to your child. During the second, third, fourth, and fifth visits, the researcher will collect your child's physical activity level using a small (a wrist-watch size) activity monitor (accelerometer) in a physical education class. The researcher will provide your child with a brief orientation how to wear the monitor before actual data collection.

The researcher will not interrupt your child's physical education class, except for the first visit. The researcher will ask your child's physical education teacher to use about 15 minutes of his/her class time to administer assent/consent process, student survey, and the activity monitor orientation.

Study Results: The study result will not be directly shared with you and your child. However, the result will be a part of the student researcher's master's thesis, and presented and published in an internationally recognized academic conference meeting and journal. Your child's identity and personal information will not be included in the presentation and publication.

#### **5. WHAT ARE THE RISKS AND POSSIBLE DISCOMFORTS OF THIS STUDY?**

There are no foreseeable risks for this study. The paper-and-pencil questionnaires will not include any personal information that can identify you. The information and data collected from each participant will remain confidential and be stored in the UW-L Physical Education Pedagogy Lab with an anonymous manner.

#### **6. WHAT ARE THE BENEFITS OF THIS STUDY?**

This study will not directly benefit you and your child. However, current project will provide a sound theoretical base to develop effective intervention programs and to increase your child's physical activity level in physical education classes. Eventually, it is expected that the study findings help your child develop and maintain healthy life styles in the future.

#### **7. WILL MY CHILD BE PAID FOR BEING IN THIS STUDY?**

Your child will not be paid for being in this research study.

#### **8. WHO WILL SEE THE INFORMATION MY CHILD GIVES?**

The information your child provides during this research project will be kept confidential to the extent permitted by law. To help ensure confidentiality, we will use identification code numbers only on data forms. All research records, including this consent form with your mobile number, will be stored securely in locked filing cabinets and/or a password-protected computer, and only researchers will have access to the records. If the results of this project are presented and/or published your child's identity will not be made public.

#### **9. WHAT OTHER CHOICES DOES MY CHILD HAVE IF MY CHILD DOES NOT TAKE PART IN THIS STUDY?**

Participation in this study is voluntary. If your child decides to participate, your child is free to withdraw at any time without penalty. Your child will not be treated differently if he/she decides to stop taking part in the study. If your child chooses to withdraw from this project before it ends, the researchers may keep information collected about your child and this information may be included in study reports.

#### **10. WHO DO I CONTACT IF I AND MY CHILD HAVE QUESTIONS?**

If you and/or your child have any questions about this research project, please contact: the principal investigator, Yongju Hwang at 608-466-0795 or by email at [hwang.yongju@uwlax.edu](mailto:hwang.yongju@uwlax.edu) or the faculty advisors, Jooyeon Jin at [jooyeon.jin13@gmail.com](mailto:jooyeon.jin13@gmail.com) or Richard Mikat at 608-785-8177 or by email at [rmikat@uwlax.edu](mailto:rmikat@uwlax.edu). If you and/or your child have questions about your rights or protection of human subjects, please contact the UW-La Crosse Institutional Review Board (IRB) Office, at 608-785-8124 or by email at [IRB@uwlax.edu](mailto:IRB@uwlax.edu)

**11. ASSENT STATEMENT**

Assent process for your child will be completed during his/her physical education class. This research study will be explained to your child in proper language your child can understand. Your child will be encouraged to ask questions about the study at any time.

**12. WHAT DOES MY SIGNATURE ON THIS CONSENT FORM MEAN?**

Your signature indicates that this study has been explained to you, that your questions have been answered, and that you agree to take part in this study.

Your Child's Name (printed): \_\_\_\_\_

\_\_\_\_\_  
(Parent/Guardian/ Legally Authorized Representative) (Date)

\_\_\_\_\_  
(Signature of Person Obtaining Consent) (Date)

APPENDIX B  
QUESTIONNAIRE

## Self-Determination Theory Questionnaire

### A. Experience of need satisfaction and frustration

**Instruction:** The following questions deal with how you feel *in general*. Please circle one number, namely that number that fits best with what you think or feel in general. For each question there are five possible answers.

	Completely not true				Completely true
1. I feel free to choose which activities I do.	1	2	3	4	5
2. Most of the things I do, I do because I have to.	1	2	3	4	5
3. The people that I like, also like me.	1	2	3	4	5
4. I feel excluded from the group I want to be a part of.	1	2	3	4	5
5. I can do things well.	1	2	3	4	5
6. I often have doubts about whether I'm good at things.	1	2	3	4	5
7. I do the things I do because I really want to do them.	1	2	3	4	5
8. I feel forced to do many things that I actually do not want to do.	1	2	3	4	5
9. I feel close to the people I care about.	1	2	3	4	5
10. I feel that the people who are important to me are unkind to me.	1	2	3	4	5
11. I am good at what I do.	1	2	3	4	5
12. I feel disappointed in a lot of things I do.	1	2	3	4	5
13. I choose to do the things I do because I want to do them.	1	2	3	4	5
14. I feel pressured to do too many things.	1	2	3	4	5
15. I feel close to and connected with the people who are important to me.	1	2	3	4	5
16. The people I spend time with don't like me.	1	2	3	4	5
17. I can achieve my goals.	1	2	3	4	5
18. I feel insecure about what I am able to do.	1	2	3	4	5
19. I find the things I do really interesting.	1	2	3	4	5
20. I do the things I do every day because I have to, not because I want to.	1	2	3	4	5
21. I have warm feelings towards the people I spend time with.	1	2	3	4	5
22. I feel that the relationships I have with other people are easily broken.	1	2	3	4	5
23. I am good at difficult tasks.	1	2	3	4	5
24. I sometimes feel like a failure when I make mistakes.	1	2	3	4	5

**B. Motivational outcomes**

**Instruction:** Please indicate how true each of the listed statements is for you by encircling a number between 1 (*Not true for me*) to 5 (*Very true for me*).

	Not True	Rather not True	Neutral	Rather true	Very true
1. I put effort in this PE class because I otherwise get criticized.	1	2	3	4	5
2. I put effort in this PE class because others (parents, friends, etc.) will appreciate me less.	1	2	3	4	5
3. I put effort in this PE class because it is the only way to please others (parents, friends, etc.).	1	2	3	4	5
4. I put effort in this PE class because I felt the pressure of others (parents, friends, etc.) to participate.	1	2	3	4	5
5. I put effort in this PE class because I have to prove myself.	1	2	3	4	5
6. I put effort in this PE class because it is the only way to be proud of myself.	1	2	3	4	5
7. I put effort in this PE class because I would feel like a failure if I didn't.	1	2	3	4	5
8. I put effort in this PE class because I would feel guilty if I didn't.	1	2	3	4	5
9. I put effort in this PE class because I find this PE class personally meaningful.	1	2	3	4	5
10. I put effort in this PE class because I fully recognize the usefulness of this PE class.	1	2	3	4	5
11. I put effort in this PE class because this PE class is personally important to me.	1	2	3	4	5
12. I put effort in this PE class because I value the benefits of this PE class.	1	2	3	4	5
13. I put effort in this PE class because I enjoy this PE class.	1	2	3	4	5
14. I put effort in this PE class because I find this PE class a pleasurable activity.	1	2	3	4	5
15. I put effort in this PE class because this PE class fun.	1	2	3	4	5
16. I put effort in this PE class because I get pleasure and satisfaction from participating in this PE class.	1	2	3	4	5
17. I don't put effort in this PE class because I don't see why this PE class is part of the curriculum.	1	2	3	4	5
18. I don't put effort in this PE class because I don't see why I should bother participating in this PE class.	1	2	3	4	5
19. I don't put effort in this PE class because I don't see the point of this PE class.	1	2	3	4	5
20. I don't put effort in this PE class because I think this PE class is actually a waste of time.	1	2	3	4	5

**C. Perceived support**

**Instruction:** Please check a box for each statement to show how much you agree or disagree with it 1 (Strongly disagree) to 7 (Strongly agree).

	Strongly disagree						Strongly agree
1. My PE teacher encourages me to ask questions.	1	2	3	4	5	6	7
2. My PE teachers is inflexible (rigid, stubborn)	1	2	3	4	5	6	7
3. My PE teacher tried to understand how I saw things before suggesting a new way to do something.	1	2	3	4	5	6	7
4. My PE teachers uses forceful language.	1	2	3	4	5	6	7
5. I feel understood by my PE teacher.	1	2	3	4	5	6	7
6. My PE teacher puts a lot of pressures on me.	1	2	3	4	5	6	7
7. My PE teacher conveys confidence in my ability to do well in this class.	1	2	3	4	5	6	7
8. My PE teacher tries to control everything I do.	1	2	3	4	5	6	7
9. My PE teacher listens to how I would like to do things.	1	2	3	4	5	6	7
10. I feel my PE teacher provides me with choices and options.	1	2	3	4	5	6	7

**D. Demographic information**

- Your Student ID: \_\_\_\_\_
- How old are you (in years)? \_\_\_\_\_ years
- What is your sex?  Male  Female
- What is your favorite physical activity/sport?
 

<input type="checkbox"/> Individual Sports (Tennis, Athletics, Bowling, Gymnastics, Golf, Skiing... etc.)	<input type="checkbox"/> Adventure/Outdoor activities (Rock Climbing, Hiking, Water Sports, Canoeing, Kayaking, Sailing)
<input type="checkbox"/> Team sports (Football, Basketball, Soccer, Dance, Hockey, Volleyball... etc.)	<input type="checkbox"/> Others (Please State) _____
- How frequently do you participate in physical activity each day after school?
 

<input type="checkbox"/> 0-1 (Hours/day)	<input type="checkbox"/> 3 (Hours/day)	<input type="checkbox"/> 5 (Hours/day)	<input type="checkbox"/> or more (Hours/day)
--	--	--	--
- How would you describe your general health?
 

<input type="checkbox"/> Poor	<input type="checkbox"/> Fair	<input type="checkbox"/> Good	<input type="checkbox"/> Very Good	<input type="checkbox"/> Excellent
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**Your survey is now complete! Thank you for your time!**

APPENDIX C

REVIEW OF RELATED LITERATURE

## **Review of Related Literature**

### **Introduction**

The purpose of this review is to synthesize the scientific literature that has examined the association between Self-determination theory (SDT; Deci & Ryan, 1985, 1991, 2000) and students' physical activity. To extend the understanding of these connections, this review offers a broad examination of the literature on a range of SDT contexts, including basic psychological needs, motivation, Autonomy-supportive and controlling teaching style, Intervention program designed to support autonomy, and questionnaires.

### **Self-determination theory**

SDT (Deci & Ryan, 1985, 1991, 2000) is a broad and useful framework to investigate young people's motivational dynamics in regards to Physical education (PE). SDT has evolved over the past 30 years. This theoretical perspective has been applied successfully to education and sport and has shown the important role of different types of motivation in inducing a number of different cognitive, behavioural, and affective outcomes.

### **Basic psychological needs**

Fundamental to self-determination theory and the central tenet of basic needs theory (Ryan & Deci, 2000a) is that satisfaction of the universal and innate needs of autonomy, competence, and relatedness represents the essential nutrients for psychological health and well-being. When these basic psychological needs are satisfied, self-determined motivation, psychological growth, and well-being are promoted (cf. Ryan & Deci, 2002). Conversely, when these needs are not nurtured, autonomous motivation,

well-being, and optimal functioning are diminished (Ryan & Deci, 2000). Specifically, the need for autonomy refers to the experience of being the initiator of one's actions and to a sense of psychological freedom when engaging in an activity (Deci & Ryan, 2000). The need for competence refers to the feeling of being effective and to the experience of confidence in achieving desired outcomes (Skinner & Belmont, 1993). The need for relatedness refers to experiences of positive and mutually satisfying relationships, characterized by a sense of closeness and trust (Ryan & Deci, 2000a). Much like an absence of teacher autonomy support does not necessarily entail the presence of a controlling style, it is argued increasingly in SDT that need frustration is distinct from an absence of need satisfaction (Bartholomew, Ntoumanis, Ryan, Bosch, et al, 2011; Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011; Vansteenkiste & Ryan, 2013). When frustrated, the needs would manifest in feelings of pressure (autonomy need frustration), inferiority and failure (competence need frustration), and loneliness and alienation (relatedness need frustration). We note that whereas Bartholomew, Ntoumanis, Ryan, Bosch, et al (2011) and Bartholomew, Ntoumanis, Ryan, and Thøgersen-Ntoumani (2011) used the term need thwarting to reflect students' personal feelings, we prefer, consistent with other work (e.g., De Meyer et al., 2014; Vansteenkiste & Ryan, 2013), to use the term need frustration. This is because the term need frustration more closely reflects students' personal experiences (in the same way as need satisfaction does), whereas the term need thwarting is used in reference to contextual features that undermine students needs.

The distinction between need satisfaction and need frustration is said to be important because both processes would have differential antecedents and outcomes

(Vansteenkiste & Ryan, 2013). Specifically, teacher autonomy support would be particularly important for fostering experiences of need satisfaction (Ryan & Deci, 2000b). An autonomy-supportive teacher would, for instance, display a sincere interest in the way students dealt with an exercise and asks them whether they need any additional help. In such a situation, students probably feel they have a say in how to proceed (autonomy satisfaction), are perhaps more likely to feel more confident to improve their skills (competence satisfaction), and feel understood by their teacher (relatedness satisfaction). For need frustration to occur, teachers would not simply have to be low on autonomy support but would engage in an actively controlling style. To illustrate, it is not because students experience few opportunities for choice (low autonomy need satisfaction) that they feel pressured to engage in activities against their will (autonomy need frustration). It is especially when teachers engage in controlling behaviors that students may feel pressured to change their behavior (autonomy frustration), may start to doubt their capabilities (competence frustration), and may feel rejected and disliked by the teacher (relatedness frustration). Consistent with this reasoning, Bartholomew, Ntoumanis, Ryan, Bosch, et al (2011) showed that while autonomy-supportive coaching was related more closely to athletes' experiences of need satisfaction, controlling coaching was related primarily to athletes' experiences of need frustration. To the best of our knowledge, the differential role of autonomy-supportive and controlling teaching in relation to need satisfaction and need frustration has not yet been examined in the context of PE.

Apart from being associated differentially with separate teaching style dimensions, need satisfaction and need frustration would also have differential relations

to students' motivational outcomes. While need satisfaction is considered conducive to individuals' engagement, well-being, and adaptive motivation (e.g., Mouratidis, Vansteenkiste, Lens, & Sideridis, 2011), it is increasingly recognized that need frustration represents a vulnerability factor for maladaptive motivation, ill-being, and even psychopathology (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011; Vansteenkiste & Ryan, 2013). Consistent with this claim, need satisfaction has been found to relate fairly specifically to positive outcomes (e.g., vitality, positive affect), whereas need frustration has been found to relate more strongly to negative outcomes (e.g., disordered eating, depressive symptoms, burn-out, and stress) in samples of athletes (Bartholomew, Ntoumanis, Ryan, Bosch, et al, 2011; Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011). Similar findings were obtained in samples of sport coaches (Stebbing et al., 2012), trainees in a police officer program (Gillet et al., 2012), and adolescents involved in a diary study (Verstuyf et al., 2013). In the context of PE, the differential role of need satisfaction and need frustration in the prediction of motivational dynamics deserves greater attention.

## **Motivation**

It is important to understand the motivational, cognitive, and affective processes that can determine whether children will regard PE as a valuable, enjoyable, and rewarding experience, or as a worthless, boring, and humiliating one. To this direction, the self-determination approach to motivation (Deci & Ryan, 1985, 1991; Deci, Vallerand, Pelletier, & Ryan, 1991; Frederick & Ryan, 1995; Vallerand, Deci, & Ryan, 1987) can be particularly helpful. This theoretical perspective has been applied

successfully to education and sport and has shown the important role of different types of motivation in inducing a number of different cognitive, behavioural, and affective outcomes. Self-determination theory argues that behaviour can be broadly categorised as intrinsically motivated, extrinsically motivated, or amotivated. According to Deci and Ryan (1991), intrinsically motivated behaviours can occur without external rewards (e.g., trophies), are undertaken out of interest in the activity itself rather than the outcomes of the activity, and are optimally challenging. In contrast, extrinsically motivated behaviours are evident when the activity is carried out as a means to an end and not for its own sake. Lastly, amotivated behavior can be found in situations where individuals are neither intrinsically nor extrinsically motivated. Amotivation refers to situations where individuals perceive no contingencies between outcomes and their actions, where they experience feelings of incompetence and uncontrollability (Vallerand, Pelletier, Blais, Briere, Senecal, & Vallieres, 1992).

Four types of extrinsic motivation have been described by Deci and Ryan (1985, 1991): external regulation, introjected regulation, identified regulation, and integrated regulation. External regulation represents behaviours which are regulated through external means, such as rewards or punishment (e.g., 'I take part in PE because I'll get into trouble if I don't'). Introjected regulation refers to behaviours which are beginning to be internalised, but they are not fully self-determined. These behaviours can be performed, for example, in order to gain social recognition or avoid internal pressures and feelings of guilt (e.g., 'I take part in PE because I would feel bad about myself if I didn't'). With identified regulation, behaviour becomes more self-determined. The outcomes of the behavior are highly valued and the latter is performed with less pressure

even if it is not particularly pleasant (e.g., 'I take part in PE because I want to improve my sport skills' ). Lastly, integrated regulation represents the most self-determined form of the internalisation process. It refers to behaviours which are performed out of choice in order to harmonise and bring coherence to different parts of the self (e.g., 'I take part in PE because it is very important for me to have a healthy life style' ). Deci and Ryan (1991) emphasised that although identified regulation represents fully integrated and self-determined forms of behaviour, it is still an extrinsically motivated behaviour because it is performed in order to achieve personal goals and not for its inherent appeal.

The different types of motivated behaviours can be ordered along a self-determination continuum. From lower to higher levels of self-determination, they are amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic motivation. External regulation and introjected regulation are considered to be controlling forms of motivation, whereas identified regulation, integrated regulation, and intrinsic motivation are viewed as self-determined forms.

The antecedents and outcomes of different types of motivation have been outlined by Vallerand (2000) in his hierarchical model of motivation. This hierarchical model of motivation is framed in terms of social environmental variables that affect feelings of autonomy, competence, and relatedness and, in turn, different types of motivation and motivational consequences (Vallerand, 2000). It can be expressed through a chain of processes as follows: "social environment factors → psychological need satisfaction → types of motivation → consequences" (Vallerand, 1997, 2000; Ntoumanis, 2001).

Based on the hierarchical model of motivation, the motivational sequence of "social environment factors → psychological need satisfactions types of motivation →

consequences" can be extensively applied to physical activity settings (Vallerand, 2000). For instance, Ntoumanis (2001) reported that social environmental factors, including cooperative learning, self-referenced improvement, and choices of tasks, were positively related with students' perceived competence, autonomy, and relatedness in physical education classes. Ntoumanis (2005) also found that autonomy support provided by the physical education teachers was related to student need satisfaction, which in turn predicted self-determined motivation. Standage, Duda, and Ntoumanis (2003) reported that perceptions of an autonomy-supportive climate positively influenced hypothesized mediating variables (i.e., autonomy, competence, relatedness) to foster self-determined motivation. Research evidence also supports the notion that students participating in an autonomy-supportive physical activity class are more likely to be intrinsically motivated to be physically active in their leisure time (Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005).

Previous research in the context of school PE (see Ntoumanis & Standage, 2009 for an overview) has shown that autonomous motivation predicts higher activity levels and greater engagement (Aelterman et al., 2012), higher concentration (Ntoumanis, 2005) and more participation in optional physical activities (Haerens, Kirk, Cardon, De Bourdeaudhuij, & Vansteenkiste, 2010; Taylor et al., 2010). In contrast, controlled forms of motivation are usually linked to negative outcomes such as boredom (Ntoumanis, 2001), unhappiness (Standage, Duda, & Pensaard, 2005), and decreased intention to participate in physical activity (Haerens et al., 2010)

### **Autonomy-supportive and controlling teaching style**

SDT specifies teachers' interaction style as an important contextual factor influencing students' motivation. Particular attention has been paid to the degree to which teachers interact with their students in an autonomy-supportive (relative to a controlling) way (Reeve, 2009). Autonomy-supportive teachers adopt the students' perspective, highlight the relevance of learning activities, offer meaningful choices, and encourage initiative taking. Controlling teachers impose their own frame of reference, thereby pressuring students to think, feel, or behave in particular ways, for instance, through the use of threats of sanction, controlling language, and guilt-induction. Correlational and experimental studies found autonomy-supportive teaching to be associated with autonomous motivation, engagement and higher grades, while controlling teaching behaviour was found to be related to amotivation and controlled motivation, disengagement, and resentment vis-a-vis the teacher (Ntoumanis & Standage, 2009; Reeve, 2009).

Herein, we examined the impact of an autonomy-supportive and controlling style on student engagement and oppositional defiance, two outcomes that received relatively little attention in prior experimental work. Engagement reflects students' behavioural, emotional, and cognitive involvement. It is a malleable construct which has been studied extensively (see Christenson, Reschly, & Wylie, 2012) and which yields manifold desirable outcomes, such as better learning, higher grades, and less drop-out (Skinner, Kindermann, Connell, & Wellborn, 2009; Skinner, Wellborn, & Connell, 1990). In addition, engagement is considered an observable indicator of students' underlying motivation in school in general (Reeve, Jang, Carrell, Jeon, & Barch, 2004; Skinner & Belmont, 1993) and in physical education in particular (Ferrer-Caja & Weiss, 2000;

Ntoumanis, 2001). In spite of its presumed importance, engagement and its relation with underlying motivational processes has primarily received attention in correlational studies, but far less in experimental research. These correlational studies have shown that perceived autonomy-supportive teaching is related to engagement, both within and across time (e.g., Reeve, 2013).

Whereas autonomy-supportive teaching may be primarily conducive to positive outcomes, controlling teaching may elicit more negative outcomes, including oppositional defiance (Bartholomew, Ntoumanis, Ryan, Bosch, & Thogersen-Ntoumani, 2011; Vansteenkiste & Ryan, 2013). Oppositional defiance has been defined as a blunt rejection of the request of an authority figure, as reflected in a tendency to do the opposite of what is expected. It is conceived as a defensive, compensatory way of coping with a controlling environment (Skinner, Edge, Altman, & Sherwood, 2003; Vansteenkiste & Ryan, 2013). Research in the parenting context indicates that adolescents' oppositional defiance vis-a-vis their parents is related to externalizing and internalizing behavioural problems (Van Petegem, Soenens, Vansteenkiste, & Beyers, 2015). Similarly, in the context of PE, oppositional defiance as experienced during a single lesson was found to relate positively to feelings of resentment vis-a-vis the content of the lesson and the teacher (Aelterman, Vansteenkiste, Soenens, & Haerens, submitted). In addition, a few studies in the parental and educational context demonstrated that a controlling way of interacting with students is related to higher levels of oppositional defiance. Vansteenkiste, Soenens, Van Petegem, and Duriez (2014) found that a controlling parental style of introducing a prohibition predicted increasing levels of oppositional defiance in adolescents. Similarly, in the PE context perceived controlling

teaching was found to relate to more oppositional defiance in students (Haerens, Aelterman, Vansteenkiste, Soenens, & Van Petegem, 2015).

### **Intervention program designed to support autonomy**

Many researchers have been studied the intervention programs to help teachers to become more autonomy supportive teacher. As for provide meaningful rationales, participants provided with a rationale that explained why task engagement was a personally beneficial thing to do self-reported greater perceived autonomy and task importance and showed greater task engagement than did participants who worked on the same task or lesson without an explanatory rationale (Assor et al. 2002; Jang 2008; Koestner et al. 1984; Reeve et al. 2002). As for acknowledge negative feelings, participants who had others acknowledge, accept, and even welcome their expressions of negative affect (e.g., “this is boring”) self-reported greater perceived autonomy and showed greater engagement than did participants who had their expression of negative affect criticized or suppressed (Assor et al. 2002, 2005; Reeve and Jang 2006). As for use non-controlling language, participants exposed to flexible communications (“you may...”) and non-evaluative comments self- reported greater perceived autonomy and greater task engagement than did participants exposed to language that pushed and pressured them toward specific predetermined products, solutions, answers, and desired behaviors (Assor et al. 2005; Ryan 1982; Reeve and Jang 2006; Vansteenkiste et al. 2004). As for offer choices, participants offered choices among options and invitations to self-direct their own task engagements self-reported greater perceived autonomy and task engagement than did participants given assigned tasks (Assor et al. 2002; Cordova and Lepper 1996; Perry 1998; Reeve et al. 2003; Zuckerman et al. 1978). As for nurture inner

motivational resources, participants showed greater constructive motivation and task engagement when others built their requested task engagements around their interests (Schraw and Lehman 2001), intrinsic motivation (Gottfried et al. 1994), autonomy (Reeve and Jang 2006), competence (Ryan and Grolnick 1986), relatedness (Furrer and Skinner 2003), sense of challenge (Clifford 1990), and intrinsic goals (Vansteenkiste et al. 2005).

People can learn to be significantly more autonomy-supportive toward others, and this has been shown to be true in empirical studies with pre-service teachers (Barch 2006; Reeve 1998), elementary school teachers (Collins 2001; deCharms 1976), middle school physical education teachers (Chatzisarantis and Hagger 2009; Tessier et al. 2008), high school teachers (Reeve et al. 2004b), college exercise instructors (Cheon and Moon 2010; Edmunds et al. 2008), coaches (Sullivan 2005), parents (Froiland, under review; Weber-Gasparoni, in preparation), physicians (Williams et al. 1999, 2002), counselors (Williams et al. 2006b), medical interns (Williams and Deci 1996), and company managers (Hardré and Reeve 2009). Su and Reeve (2011) identified that the relatively more effective intervention programs were structured in ways that trained multiple elements of autonomy support and were presented in relatively brief (1–3 h) sessions in a laboratory training setting that focused on skill-based activities and utilized multiple types of media to deliver its content. Furthermore, relatively effective intervention programs were offered to teachers (rather than to other professionals), trainees (rather than to experienced professionals), and individuals with an autonomy (rather than a control)

causality orientation. Based on this point of view, this review offers two recent autonomy-supportive intervention program.

First, Cheon Reeve, and Moon (2012) proposed an autonomy-supportive intervention program (ASIP). The ASIP was provided in three waves. Part 1 was a 3-hr workshop-like experience. It began with a reflective warm-up activity in which teachers read two teaching scenarios, one that described highly autonomy-supportive teaching and another that described highly controlling teaching, and answered questions about how well these scenarios described their own teaching. A media-rich PowerPoint presentation followed to discuss the nature of student motivation (what it is, where it comes from), teachers' motivating styles toward students, classroom examples of autonomy-supportive instruction, and empirical evidence on the benefits of teacher-provided autonomy support. Part 1 concluded with a group discussion about the feasibility, potential obstacles, and specific "how to" ideas related to enacting an autonomy-supportive style in the context of the Korean PE classroom.

Part 2 took place 6 weeks later, and it lasted 2 hr. It began with a brief PowerPoint presentation of autonomy-supportive teaching that reinforced the presentation from Part 1. Teachers then engaged in a group discussion about the autonomy supportive instructional behaviors they had experimented with to that point in the semester. It was a shared information and discussion session in which teachers voiced their concerns, identified potential obstacles, and shared, suggested, and critiqued specific approaches to instruction, usually within the context of a specific sport-based activity (e.g., during a badminton activity).

Part 3 took place 6 weeks later. It consisted of a group discussion that centered largely around sharing ideas in how to be autonomy supportive during PE instruction. After SAIP, the students of the trained teachers, perceived that their teachers became more autonomy supportive and less controlling, they experienced psychological need satisfaction, and they reported meaningful gains in their classroom engagement, skill development, future intentions, and course achievement.

Second, Aelterman, Vansteenkiste, Van keer, Demeyer, Van den Berghe & Haerens (2013) development and evaluation of a training initial standardized half-day (i.e. 3 h) training consisting of three parts: (1) Part I: theoretical background, (2) Part II: overview of motivating teaching strategies, and (3) Part III: application exercise. In Part I, SDT was introduced as the theoretical framework. Through interactive exercises the qualitative distinction between autonomous and controlled forms of motivation and amotivation was elucidated. PE teachers were invited to share concrete examples from their daily lives (e.g., ‘Are you attending this training voluntarily or because the principal told you to do so?’). From this perspective, the focus gradually shifted from PE teachers’ motivation to students’ different motives to participate in PE. By sharing experiences, a sense of connectedness among the participants was created. Furthermore, starting from teachers’ insights in and awareness of their personal functioning is likely to increase their appreciation of the message and their willingness to participate and change, because of the experienced autonomy satisfaction. In addition to motivational regulations, the concepts of need satisfaction and need support were introduced and empirical evidence was provided to support the argument that when students feel supported in their needs for

autonomy, competence and relatedness, they better enjoy PE and acknowledge the value and personal benefits associated with PE.

Part II consisted of an overview of specific instructional strategies to create a more need-supportive class environment promoting an optimal motivation. During this part, teachers were presented eight concrete strategies to support students' needs for autonomy and competence. With regard to autonomy-support, (1) adopting an empathic attitude, (2) providing choice, (3) offering a rationale, and (4) integrating fun elements, were put forward. As for structure, PE teachers were provided with strategies such as (1) giving an overview and communicating expectations, (2) offering help, (3) giving positive feedback, and (4) encouragement. To avoid an overload of information and because relatedness-support often co-occurs with autonomy-support and even structure, involvement-promoting strategies were not presented as a separate category, but rather as general basic teaching qualities that help support autonomy and provide structure (Reeve & Jang, 2006). For each of the eight strategies the applicability and feasibility was illustrated by concrete practical examples and video images of authentic PE classes.

In Part III, PE teachers were given the opportunity to practice the proposed motivating strategies. In groups of three or four, teachers received a paper version plan of a volleyball lesson and were asked to revise or optimize this plan by integrating as much proposed strategies as possible. They had about 15 min to finish this paper-and-pencil exercise. In the next 15 min, the proposals and alternative actions were exchanged and discussed with the whole group. After training, the trained teachers highly valued opportunities for active participation, collaboration and experiential learning (e.g. microteaching). Of particular interest was the unexpected essential value they placed on

theoretical knowledge. In addition, it was critical to be authentic to the content by delivering the training in a need-supportive fashion.

## **Questionnaires**

### ***Motivational outcome.***

A number of instruments has been used to measure behavioral regulations in physical activity contexts such as the Sport Motivation Scale (SMS; Pelletier, Fortier, Vallerand, Tuson, & Blais, 1995), the Sport Motivation Scale-6 (SMS-6; Mallett, Kawabata, Newcombe, Otero-Forero, & Jackson, 2007), the Behavioral Regulation in Sport Questionnaire (BRSQ; Lonsdale, Hodge, & Rose, 2008), the Exercise Motivation Scale (EMS; Li, 1999), the Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2; Markland & Tobin, 2004) and the Perceived Locus of Causality Scale (PLOC) for PE (Goudas, Biddle, & Fox, 1994). Given the necessity to measure behavioral regulations in a specific context using domain-specific instruments (Ryan, 1995; Vallerand, 1997), the instrument of choice in most of the studies examining students' motivation in PE has been the PLOC that was based on the Academic Self-Regulation Questionnaire (ASRQ: Ryan & Connell, 1989) after adding an amotivation subscale from the Academic Motivation Scale (AMS: Vallerand et al., 1992) and measures amotivation, external regulation, introjected regulation, identified regulation, and intrinsic motivation. Valid conclusions on the role of behavioral regulations in students' motivational processes in PE require sound psychometric

properties of the instruments used to assess these types of regulations. A number of studies has examined various psychometric aspects of the PLOC scores. Chatzisarantis, Hagger, Biddle, Smith, and Wang (2003) used meta-analysis to examine the validity of the self-determination continuum of the PLOC constructs across exercise, sport, and PE and concluded in favor of the validity of the continuum in relation to external regulation, introjected regulation, and identified regulation supporting at the same time the independence of internalization processes based on extrinsic motivation and intrinsically motivated processes. Wang, Hagger, and Liu (2009) examined the factor structure and cross-cultural invariance of PLOC responses across British and Singaporean students in PE and concluded in favor of a sound factor structure and simplex like pattern of construct relations within each population and their invariance across the populations. Further, Wang, Pyun, Kim, and Chatzisarantis (2009) using multi-group invariance analyses found that in a large group of Singaporean students, primary and secondary school students perceived the content of several PLOC items of the introjected regulation, intrinsic motivation, and amotivation subscales differently. These results indicate that the instrument may function differently across the groups leading to inappropriate cross-group comparisons and they argued for the need of further psychometric examination of the equivalence in meaning of the PLOC items before proceeding to meaningful comparative research between school grade levels. Lonsdale, Sabiston, Taylor, and Ntoumanis (2011) examined the internal reliability indices of the PLOC subscales using responses from British and Honk Kong students in PE and found

that while reliability indexes were satisfactory in the British sample, the indexes for external and introjected regulation subscales in the Honk Kong sample were low. They argued that current introjected regulation items may not be internally consistent as they measure different dimensions of introjected regulation such as the motive to enhance contingent self-worth (e.g., “I want the teacher to think I am a good student”) and the motive to avoid low contingent self-worth (e.g., “Because it bothers me when I don’t participate in PE”) (Assor, Vansteenkiste, & Kaplan, 2009). Further, despite that factorial validity was generally supported, identified regulation items were not distinguished from intrinsic motivation items and this was the case in other studies in PE with strong correlations emerging between these two subscales. For instance, Standage, Duda, and Ntoumanis (2005) reported a correlation of .99 while Taylor and Ntoumanis (2007) reported a correlation of .83.

This PLCS was translated into Korean version according to the Guidelines for Translating and adapting tests given by the International Test Commissions (ITC). In order to test the validity and reliability of Korean version of PLCS, the researchers performed the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to confirm the factorial validity, as well as internal consistency and correlations among five variables. As a result, the Korean version of PLCS had 5 factors with 19 items, and eliminated 1 item from introjected regulation. Overall, the PLCS demonstrated high internal consistency and good factorial validity.

***Perceived autonomy-supportive and controlling teaching and Experience of need satisfaction and need frustration.***

Cheon et al. (2014) used five questionnaires in their study. To assess perceptions of autonomy-supportive teaching, they used the six-item short version of Learning Climate Questionnaire (Williams & Deci, 1996). This measure has been used successfully in previous studies to assess autonomy-supportive teaching (Black & Deci, 2000; Jang et al., 2009). A sample item is, “My PE teacher provides us with choices and options.” Scores on the Learning Climate Questionnaire were internally consistent throughout each assessment period ( $\alpha = .88$  at T1;  $\alpha = .93$  at T2;  $\alpha = .95$  at T3).

To assess perceptions of controlling teaching, researchers used the four-item Controlling Teacher Scale (Jang et al., 2009). This measure has also been used successfully in previous studies (Cheon & Reeve, 2013; Jang et al., 2009). A sample example item is, “My PE teacher puts a lot of pressure on me.” Scores on the Controlling Teacher Scale were internally consistent throughout each assessment period ( $\alpha = .81$  at T1;  $\alpha = .86$  at T2;  $\alpha = .90$  at T3).

To assess psychological need satisfaction, students completed the Korean translated versions of the five-item Perceived Autonomy Scale to assess autonomy need satisfaction (Standage, Duda, & Ntoumanis, 2006), the four-item Perceived Competence subscale from the Intrinsic Motivation Inventory to assess competence need satisfaction (McAuley, Duncan, & Tammen, 1989), and the four-item Relatedness to Teachers Scale to assess relatedness need satisfaction (Furrer & Skinner, 2003). Each of these measures has been used successfully in previously published research to assess need satisfaction within the PE secondary school context (Cheon et al., 2012; Ntoumanis, 2001). Scores on the Perceived Autonomy Scale (e.g., “In this PE class, I feel that I do PE activities because I want to.”) showed acceptable internal consistency ( $\alpha = .89$  at T1;  $\alpha = .93$  at T2;

$\alpha = .95$  at T3); scores on the Perceived Competence Scale (e.g., “I think I am pretty good at physical education.”) showed acceptable internal consistency ( $\alpha = .92$  at T1;  $\alpha = .93$  at T2;  $\alpha = .93$  at T3); and scores on the Relatedness to Teachers Scale (e.g., “When I am with my PE teacher, I feel accepted.”) showed acceptable internal consistency ( $\alpha = .78$  at T1;  $\alpha = .82$  at T2;  $\alpha = .84$  at T3). Scores from the three need satisfaction scales were positively inter-correlated across each of the three assessment periods, so we followed the tradition in this literature (Deci et al., 2001; Standage, Duda, & Ntoumanis, 2005) to create a single need satisfaction composite score by averaging participants’ scores for autonomy, competence, and relatedness need satisfaction at each wave of assessment (three-item  $\alpha$ s were  $.74$  at T1,  $.81$  at T2, and  $.84$  at T3). To justify treating the three measures as a single score, researchers calculated a series of three exploratory factor analyses by entering students’ mean scores on autonomy, competence, and relatedness as the three individual data points. A one-factor solution emerged from a three-item principal components analysis at T1 (eigenvalue = 2.00; 66.7% of the total variance; factor loadings of  $.87$  for autonomy,  $.81$  for competence, and  $.76$  for relatedness), at T2 (eigenvalue = 2.19; 73.1% of the total variance; factor loadings of  $.90$ ,  $.84$ , and  $.82$ , respectively), and at T3 (eigenvalue = 2.29; 76.5% of the total variance; factor loadings of  $.92$ ,  $.86$ , and  $.84$ , respectively).

To assess psychological need frustration, students completed the 12-item Psychological Need Thwarting Scale (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011), a scale has been used successfully in published research (Gunnell et al., 2013). The Psychological Need Thwarting Scale includes a four-item subscale to assess autonomy need frustration (“In PE class, I feel pushed to behave in certain ways.”) that

showed acceptable internal consistency ( $\alpha = .88$  at T1;  $\alpha = .93$  at T2;  $\alpha = .95$  at T3), a four-item subscale to assess competence need frustration (“In PE class, there are situations where I am made to feel inadequate.”) that showed acceptable internal consistency ( $\alpha = .83$  at T1;  $\alpha = .88$  at T2;  $\alpha = .91$  at T3), and a four-item subscale to assess relatedness need frustration (“I feel rejected by my PE teacher.”) that showed acceptable internal consistency ( $\alpha = .86$  at T1;  $\alpha = .91$  at T2;  $\alpha = .94$  at T3). Scores from the three need frustration scales were positively inter-correlated across each of the three assessment periods, so researchers again created a single need frustration composite score by averaging participants’ scores for autonomy, competence, and relatedness at each wave of assessment (three-item  $\alpha$ s were .90 at T1, .94 at T2, and .96 at T3). To justify treating the three measures as a single score, researchers again calculated a series of exploratory factor analyses by entering students’ mean scores on autonomy, competence, and relatedness as the three individual data points. A one-factor solution emerged from a three-item principal components analysis at T1 (eigenvalue = 2.52; 84.1% of the total variance; factor loadings of .92 for autonomy, .93 for competence, and .90 for relatedness), at T2 (eigenvalue = 2.67; 89.0% of the total variance; factor loadings of .95, .95, and .93, respectively), and at T3 (eigenvalue = 2.77; 92.5% of the total variance; factor loadings of .96, .96, and .95, respectively).

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