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Perceived Teaching Behaviors and Self-Determined Motivation in Physical Education: A Test of Self-Determination Theory

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In the present study, we tested the effects of specific dimensions of perceived teaching behaviors on students' self-determined motivation in physical education. In accordance with the tenets of self-determination theory (Deci & Ryan, 1985, 2000), we expected the psychological needs for competence, autonomy, and relatedness would mediate these effects. Secondary school students (N = 498) ages 12-17 years completed measures of perceived teaching behaviors for seven dimensions: (a) democratic behavior, (b) autocratic behavior, (c) teaching and instruction, (d) situation consideration, (e) positive general feedback, (f) positive nonverbal feedback, and (h) negative nonverbal feedback. They also completed measures of perceived satisfaction for competence, autonomy, relatedness, and self-determined motivation. A path-analytic model revealed a positive, indirect effect of perceived positive general feedback on self-determined motivation. The effects of perceived autocratic behavior and negative nonverbal feedback were direct and negative, whereas the effects of teaching and instruction and situation consideration were direct and positive. Results suggest that feedback, situation consideration, and teaching and instruction are essential antecedents to self-determined motivation.

Key words: intrinsic and extrinsic motivation, path analysis, psychological needs, significant other

School physical education (PE) has been recognized as one of the most important contexts for developing physical activity habits in youth (Sallis & McKenzie, 1991). Despite holding such promise, interest and participation in PE as well as physical activity levels have declined with age (Biddle, 1995). Research based on motivation theories has focused on factors in the PE environment that engender children's motivation to participate in physical activity (Hagger & Chatzisarantis, 2007, 2008; Reeve & Jang, 2006). Much of this research focused on teachers' interpersonal behaviors in PE lessons. The way

PE teachers organize lessons, include students in decision making, provide students with options, acknowledge students' feelings, and provide quality feedback are behaviors with crucial motivational implications (see Hagger & Chatzisarantis, 2007; Hein & Koka, 2007; Standage, Gillison, & Treasure, 2007). Nevertheless, little research has examined the process by which perceptions of specific teaching behaviors influence students' motivation in PE. Thus, in this study we used self-determination theory (SDT; Deci & Ryan, 1985, 2000) as a framework to examine the relationships between various perceived teaching behavior dimensions, such as democratic versus autocratic behaviors, teaching and instruction, situation consideration, verbal and nonverbal feedback, and students' self-determined motivation in PE.

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Central Tenets of SDT

SDT assumes that individuals strive to satisfy the basic psychological needs for competence, autonomy, and relatedness, which determine the quality of engagement in

a given domain (Deci & Ryan, 1985, 2000). The desire to interact effectively with the environment and experience success and control over outcomes is characteristic of the need for competence. A need for autonomy reflects an individual's free will to engage in activities and be the agent of his or her actions. Finally, a need for relatedness implies that individuals have a desire to feel connected to others when engaging in activities. These needs determine the quality of motivation people will experience when pursuing behaviors across different contexts.

SDT also distinguishes between different motives individuals have for participating in an activity (Deci & Ryan, 1985; Vallerand, 2007). These motives can be classified along a continuum between autonomous and controlling forms of motivation (Deci & Ryan, 1985). The most autonomous form is intrinsic motivation, at one extreme of the continuum. An individual who is intrinsically motivated toward a particular activity will participate purely for the inherent enjoyment, interest, and satisfaction (Deci & Ryan, 1985, 2000). Alongside intrinsic motivation are three forms of extrinsic motivation that vary in the degree of self-determination: identified, introjected, and external regulation.¹ Adjacent to intrinsic motivation is identified regulation, which reflects an individual's motive to attain personally relevant outcomes and is the most self-determined form of extrinsic motivation. Adjacent to identified regulation is introjected regulation, which reflects behaviors to avoid negative feelings of guilt and shame or to gain positive psychological outcomes, such as contingent self-worth or pride. External regulation is the most controlling form of regulation and is on the opposite pole from intrinsic motivation on the continuum; it refers to behavior controlled by external sources, such as material rewards or constraints imposed by others (Deci & Ryan, 1985).

A central tenet of SDT is that social-contextual factors (e.g., the autonomy-supportive or control by significant others, such as teachers and leaders) will influence individuals' motivation toward a particular activity. According to theory, the influence of these factors is not direct but exerted through the satisfaction of basic psychological needs. That is, the extent social factors fulfill basic psychological needs will determine the type of regulation guiding the behavior (Deci & Ryan, 2000). Satisfying these needs has been proposed as central to promoting self-determined forms of motivation (i.e., intrinsic motivation and identified regulation). On the contrary, lack of satisfaction should result in controlling forms of motivational regulation (i.e., introjected and external regulation; Deci & Ryan, 1985, 2000; Ryan & Deci, 2002).

Previous SDT Research on the Social-Contextual Characteristics in PE

In line with SDT (Deci & Ryan, 1985, 2000), a growing body of research in PE settings provided evidence that

the needs for competence, autonomy, and relatedness mediated the relationship between social-contextual factors and motivation (Ntoumanis, 2001, 2005; Standage, Duda, & Ntoumanis, 2003, 2005, 2006). Ntoumanis (2001) and Standage et al. (2003), for example, examined components of the *motivational climate* (e.g., cooperation, improvement, and choice) in promoting or thwarting students' motivation in PE. These two studies supported the positive interrelationships among the mastery-oriented motivational climate, psychological needs satisfaction, and autonomous motivation. Students' perceptions of the class climate also reflect the teacher's behaviors and teaching style; however, in these studies students were asked to complete questionnaires that, in most instances, were not directed toward assessing specific teaching behaviors.

A number of studies in PE showed a direct positive association between perceived teachers' autonomy-supportive behavior (i.e., providing choice, allowing students to initiate behavior, acknowledging students' feelings, minimizing the use of pressure to control behavior) and self-determined forms of motivation (e.g., Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003). Standage and colleagues (2006, 2007) demonstrated that secondary school students' perceptions of teacher's autonomy support positively predicted self-determined motivation through competence, autonomy, and relatedness. Importantly, autonomy support from the teacher was generalized rather than specific instructional behaviors.

A few studies in PE examined the effect of a *need-supporting* context on students' needs satisfaction and motivation (Ntoumanis, 2005; Standage et al., 2005). For example, Standage et al. examined the predictive use of multifaceted need-supporting behavior from the teacher, encompassing perception of autonomy, competence, and relatedness support on students' overall need satisfaction and different types of motivational regulations. These constructs were subsumed by a global need support factor, but were distinctive at the subordinate level. However, subordinate level constructs were not latent as in previous studies (Hagger, Chatzisarantis, & Harris, 2006). Results revealed need support to positively predict students' self-determined motivation mediated by perceived need satisfaction. Again, the role of teachers' instructional behaviors on students' motivational orientation was not tested.

The Motivational Influence of Coaching Behaviors by SDT

Motivational studies in PE, using SDT (Deci & Ryan, 1985, 2000) as a framework, predominantly explored the effects of perceived teachers' autonomy-supportive interpersonal style on students' motivation as a general construct or motivational climate, while studies in a coaching context supported the association between specific

dimensions of perceived coaching behaviors, measured simultaneously, and athletes' motivation (Amorose & Horn, 2000; Hollebeak & Amorose, 2005). This research was based primarily on the Leadership Scale for Sport (LSS; Chelladurai & Saleh, 1980), which assesses coaching behaviors, such as decision-making style (i.e., democratic and autocratic), the coach's motivational tendencies (i.e., social support and positive feedback), and the coach's instructional tendencies (i.e., training and instruction). A revised version of this scale (RLSS; Zhang, Jensen, & Mann, 1997) also assesses situational factors (i.e., time, individual, environment, and game) that influence sport motivation and are labeled situation consideration.

Hollebeak and Amorose (2005) tested the relationship patterns among perceived coaching behaviors; college-age athletes' competence needs, autonomy, and relatedness; and intrinsic motivation. Based on SDT (Deci & Ryan, 1985, 2000), they expected a model specifying perceived coaching behavior to influence athletes' intrinsic motivation through competence, autonomy, and relatedness perceptions would better represent the data relative to a model that specified perceived coaching behaviors would have both direct and indirect effects on intrinsic motivation. Although both models exhibited acceptable data fit, the full mediational model demonstrated more parsimonious data representation. Specifically, Hollebeak and Amorose found all three psychological needs to positively predict athletes' intrinsic motivation. Coaches' decision-making style influenced athletes' perceptions of autonomy, with democratic behavior having a positive effect and autocratic behavior having a negative effect. Training and instruction had a positive, albeit small, effect on perceived competence. Coaches' positive feedback (i.e., praise), as expected, was a significant predictor of athletes' perceived relatedness. Unexpectedly, positive feedback was a negative influence on perceived competence. Hollebeak and Amorose explained this dissimilarity to previous studies, suggesting the athletes considered the coaches' praise as noncontingent and inappropriate, thus, interpreting positive feedback as a sign that the coach thought them incompetent. In all, the authors argued that while few unexpected relationships emerged, the study supported SDT in general. Finally, but most importantly, only democratic and autocratic behaviors had a significant indirect effect on athletes' intrinsic motivation via perceived autonomy.

Surprisingly, Hollebeak and Amorose (2005) did not assess the influence of additional coaches' behaviors, such as situation consideration, on athletes' intrinsic motivation. In the RLSS, Zhang et al. (1997) proposed situation consideration a key behavior facilitating athletes' perceptions of competence. Furthermore, the Hollebeak and Amorose study did not incorporate coaches' nonverbal behavior, which has been considered a crucial component in conveying clear and consistent messages to

athletes (Yukelson, 1998). Previous studies found coaches' nonverbal feedback to predict athletes' perceived competence, with positive nonverbal feedback having a positive effect and negative nonverbal feedback having a negative effect (Allen & Howe, 1998). In a PE context, Koka and Hein (2005) found, however, that neither positive nor negative nonverbal feedback contributed significantly to students' intrinsic motivation. They proposed that nonverbal feedback might affect students' motivation through change in their perceptions of competence.

The Present Study

Although there is empirical evidence that teachers' behaviors perceived as autonomy-supportive are positively associated with students' self-determined motivation in PE (Hagger et al., 2003, 2005; Standage et al., 2005, 2006), these studies focused on teachers' generic autonomy support rather than specific dimensions of their behaviors. The present study aimed to resolve this issue by examining the differentiated effects of teachers' specific instructional behaviors on students' self-determined motivation in PE. School students were asked to rate the frequency of specific teaching behaviors they perceived their PE teacher to exhibit in classes. Specifically, in line with previous studies in sport context (e.g., Amorose & Horn, 2000; Hollebeak & Amorose, 2005), we assessed the following specific perceived teaching behaviors: democratic versus autocratic behavior, teaching and instruction, and positive general feedback. High scores on democratic behavior characterized teachers who advocated student participation in decision-making and frequently asked students' opinion regarding game-playing strategies during lessons. High scores on autocratic behavior defined teachers who displayed a rigid decision-making style and demanded obedience from students. Teaching and instruction behavior reflect the extent to which teachers emphasized teaching and guidance to improve students' performance. Positive general feedback reflected how frequently teachers praised and encouraged students' performance and effort.

In the present study, we examined the potential of other crucial instructional behaviors, such as situation consideration and nonverbal feedback, for determining students' needs and self-determined motivation. High scores on situation consideration suggested teachers were perceived to consider students' abilities when delegating roles, such as assigning them to the right game position (Zhang et al., 1997). Positive nonverbal feedback reflected the extent to which the teacher responded to good performance and effort using positive gestures, such as clapping hands, smiling, or patting a shoulder. Negative nonverbal feedback, on the other hand, reflected the extent teachers reacted to poor performance or errors with negative gestures, such as rolling their eyes, shaking their head, or displaying an angry expression (Koka & Hein, 2005).

The present study is unique, because no other study to date examined the mechanism by which these specific dimensions affected students' self-determined motivation in PE. Moreover, research has not tested the SDT hypothesis that relationships between these dimensions and students' self-determined motivation are mediated by satisfying the psychological needs for competence, autonomy, and relatedness.

The purposes of this study were to (a) examine the specific perceived teaching behaviors positively or negatively related to students' self-determined motivation in PE, and (b) test the relationships between the teaching dimensions and students' self-determined motivation in PE by the three needs satisfaction identified by SDT. We tested a path model, in which specific teaching behaviors were expected to influence students' self-determined motivation through their perceived satisfaction of the needs for competence, autonomy, and relatedness.² According to previous work (Allen & Howe, 1998; Hollebeak & Amorose, 2005; Koka & Hein, 2005; Zhang et al., 1997), not all perceived teaching behaviors were expected to be related to each need satisfaction variable. Specifically, as illustrated in Figure 1, it was hypothesized that teachers' decision-making style would influence students' self-determined motivation through perceived satisfaction of autonomy, with democratic behavior having a positive relationship and autocratic behavior having a negative relationship. Teaching and instruction, situation consideration, and positive nonverbal feedback were hypothesized to be positively associated with students' self-determined motivation, while negative nonverbal feedback was expected to be negatively associated with self-determined motivation through perceived satisfaction of competence. Finally, the teacher's positive general feedback was hypothesized to have a positive relationship with students' self-determined motivation by mediating perceived satisfaction of the needs for competence and relatedness. According to past work in PE, satisfaction of these psychological needs was expected to be correlated (Standage et al., 2003).

To test these hypotheses, we tested an alternative model, in which we hypothesized all dimensions of perceived teaching behaviors would directly predict students' self-determined motivation. The purpose of this model was to demonstrate whether the psychological need satisfaction variables mediated the effects of perceived teaching behaviors completely, partially, or not at all. Thus, if these additional paths exhibited nonsignificant parameter estimates and the hypothesized indirect effects were significant, they would confirm the complete mediation of these effects. If both direct and indirect effects were significant, it would support partial mediation of the effects. Alternatively, if the direct paths were significant while the hypothesized indirect effects were not, there would be no support for a mediation effect.

Method

Participants and Procedures

Participants were 498 secondary school students (287 girls and 211 boys) ages 12–17 years ($M_{age} = 13.76$ years, $SD = .77$) from a town of 100,000 inhabitants located in southeastern Estonia. The sample consisted completely of Caucasians. Prior to data collection, we obtained permission for the study from the head teachers of all schools. A letter sent home with each child briefly outlined the study. If parents did not send the letter back to the school we considered that to represent informed consent from parents and participants. No letters were returned. The Ethical Committee of the University of Tartu approved the procedures and protocol for the present study.

The first author administered the questionnaires to students in their homerooms during the regular school day. Prior to completing the questionnaire, students were briefly introduced to the study idea and assured their answers would remain confidential. They were told there were no right or wrong answers and that responses should reflect their own perceptions. Students were also told they could decline to participate at any time. No student refused to participate. The questionnaire took approximately 15 min to complete, and the researcher collected completed questionnaires.

Measures

Perceived Teaching Behaviors. We used items from the RLSS (Zhang et al., 1997) to assess students' perceptions of various teaching behaviors. The original 60-item RLSS was designed to assess perceptions of various coaching behaviors with dimensions of democratic behavior, autocratic behavior, teaching and instruction, social support, positive feedback, and situation consideration.³ The original items were modified to a PE context to assess perceptions of equivalent dimensions of teaching behaviors. All items were preceded by the stem, "My PE teacher," and participants responded on 5-point scales ranging from 1 = never to 5 = always. Examples are: "...asks for the opinion of the students on strategies for specific games" (democratic behavior), "...refuses to compromise on a point with students" (autocratic behavior), "...makes complex things easier to understand and learn" (teaching and instruction), and "...sets goals that are compatible with students' ability" (situation consideration). To maintain a length suitable for school children, three items most appropriate for PE context were selected from each dimension based on subjective evaluation of the content.

To evaluate the content validity of selected questionnaire items, experts ($N = 5$) in the field judged the representativeness of the item content. The experts confirmed the suitability of the items as measures of

students' perceptions of teaching behavior. The items were then administered to a small group of secondary school students ($N = 26$). Students received standardized instructions and completed the questionnaire. They were then interviewed informally and individually and asked whether they understood the items and what they thought the items meant. Based on these interactions, it was clear students understood the concept of each item and had no difficulty completing the questionnaire. Ultimately, the scale comprised 12 items, 3 for each subscale, and is referred to hereafter as the Leadership Scale for Physical Education (LSPE).

The second questionnaire was the Perceptions of the Teacher's Feedback questionnaire (PTF; Koka & Hein, 2005), which assesses students' perceptions regarding the type of feedback their PE teachers give in response to their performances. The questionnaire includes 9 items, 3 for each subscale, representing three types of responses. These included a verbal response, such as positive general feedback (e.g., "The teacher often praises me"). The other two types were nonverbal positive (e.g., "In response to a good performance the teacher claps his/her hands") and negative feedback (e.g., "In response to a poor performance the teacher rolls his/her eyes"). The PTF included only positive verbal feedback, not negative verbal

feedback, because confirmatory factor analysis (CFA) did not support the latter items (Koka & Hein, 2005). Students indicated their agreement or disagreement with each statement on a 5-point scale ranging from 1 = strongly disagree to 5 = strongly agree. Previous work with Estonian school students of similar age supported score reliability using Cronbach's alpha and factorial structure using CFA of the PTF (Koka & Hein, 2005).

Competence Need Satisfaction. Students' perceived satisfaction of the need for competence in PE was measured using a 5-item subscale from the Intrinsic Motivation Inventory (IMI; McAuley, Duncan, & Tammen, 1989). An example item is, "I think I am pretty good at PE." Students indicated responses on a 5-point scale anchored by 1 = strongly disagree and 5 = strongly agree. Previous PE-based research involving Estonian school students of a similar age demonstrated the perceived competence subscale of the IMI produced acceptable Cronbach's alpha reliability coefficients (Koka & Hein, 2003).

Autonomy Need Satisfaction. Students' perceived satisfaction of the need for autonomy in PE was measured using three items derived from previous research assessing perceived autonomy in sport settings (Hollembek & Amorose, 2005). Items were modified by changing the content to refer to PE settings. Students reflected how

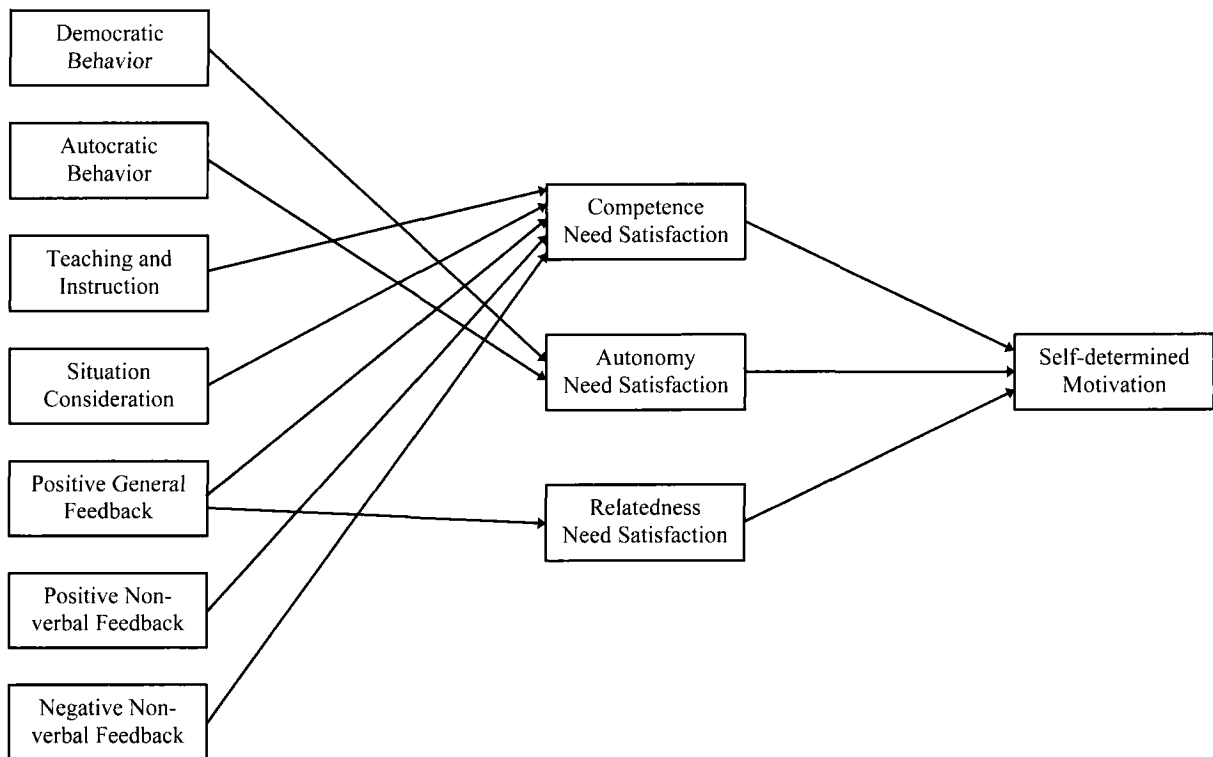


Figure 1. Hypothesized path model. (Note. For justification of the hypothesized paths, see text. For clarity, the error covariances among perceived competence, autonomy, and relatedness need satisfaction variables are omitted as well as direct paths from all dimensions of perceived teaching behaviors to self-determined motivation that were set to be free in the alternative model to test indirect and mediation effects.)

they felt about the amount of choice they had when participating in PE. A sample item included, "I have a say in what I do when participating in PE." Students responded on 5-point scales ranging from 1 = strongly disagree to 5 = strongly agree.

Relatedness Need Satisfaction. Students' perceived satisfaction of the need for relatedness was assessed using five items derived from previous research in sport settings (Holmbeck & Amorose, 2005). Items were modified by changing the target context to PE. Specifically, students responded to a common stem, "In my relationships with the classmates in PE, I feel..." with five descriptors: "...supported," "...attached to them," "...understood," "...safe," and "...close to them." They responded on 7-point scales ranging from 1 = strongly disagree to 7 = strongly agree.

Motivational Regulations. Motivation toward PE was assessed using an adapted version of the Mullan, Markland, and Ingledew (1997) Behavioral Regulations in Exercise Questionnaire (BREQ). The original scale was modified to a PE context. Participants responded to the following common question, "Why do you participate in PE?" with different reasons: intrinsic motivation (four items; e.g., "because PE is fun"), identified regulation (four items, e.g., "because I value the benefits of PE"), introjected regulation (three items; e.g., "because I feel ashamed when I miss a PE class"), and external regulation (four items; e.g., "because other people say I should"). They responded using 5-point scales ranging from 1 = strongly disagree to 5 = strongly agree.

For estimating relations among the hypothesized path model, four types of motivation were integrated into a single autonomous motivation by calculating a self-determination index (SDI). This approach assesses the extent to which individuals are relatively autonomous versus controlled, when performing certain behaviors (e.g., doing PE). The method advocated by previous researchers (e.g., Hagger et al., 2005; Standage et al., 2006) was used to calculate the SDI. Each subscale average score was weighted as follows: intrinsic motivation (+2), identified regulation (+1), introjected regulation (-1), and extrinsic regulation (-2); and a single SDI was calculated based on the weighted composite of these scores. Thus, higher scores on the SDI represented higher levels of autonomous motivation (i.e., intrinsic motivation and identified regulation; Ryan & Deci, 2002) and lower levels of controlling motivation (i.e., introjected and external regulation; Ryan & Deci, 2002).

Translation Procedures

Items from the questionnaires were adapted to a PE context before using the standardized back-translation techniques suggested by Brislin (1986) to produce an Estonian version of the LSPE, perceived autonomy, per-

ceived relatedness, and BREQ questionnaires. After that, a translator translated the items into Estonian, and then two independent translators translated them back into English. The back-translated versions were compared with the English versions, and any inconsistencies and errors were highlighted. These inconsistencies were removed in a further translation. The back-translation comparison was repeated until the versions were identical. The final questionnaires exhibited no discrepancies.

Data Analysis

Data were analyzed in two parts. In the first, the factor structure of these scales was examined via CFA prior to main analysis, because some multidimensional scales were devised (i.e., the LSPE) or adapted for the PE context (i.e., the BREQ). Also, descriptive statistics and internal reliability coefficients (Cronbach's alpha) were calculated for all measures. In the second part, a path analysis with averaged manifest scales for each construct was conducted to test the hypothesized models using LISREL 8.51 (Jöreskog & Sörbom, 1996). A maximum likelihood method was used to estimate parameters of both CFA and path models.

Several indexes were used to assess the adequacy of data fit for both CFA and path models. The overall fit was examined using the chi-square (χ^2) test. A nonsignificant χ^2 indicated the model provided an acceptable data fit. It is known, however, that χ^2 is sensitive to sample size, and, thus, supplementary fit indexes were also used (Hu & Bentler, 1999). According to the suggestion by Hu and Bentler (1999), a good model that fits is indicated when values for comparative fit index (CFI) and nonnormed fit index (NNFI) are close to or greater than .95, and values for standardized root mean square residual (SRMSR) and root mean square error of approximation (RMSEA) are .08 and .06 or less, respectively.

Results

CFA Models, Descriptive Statistics, and Scale Reliabilities

A CFA for the LSPE yielded acceptable fit indexes, $\chi^2(48) = 72.85$, $p = .01$, χ^2/df ratio = 1.52, CFI = .97, NNFI = .96, SRMSR = .031, RMSEA = .032; the 90% confidence interval (CI_{90}) for RMSEA range from .016 to .047, supporting validity of the four-factor model of perceived teaching behaviors in PE. While there were strong and significant correlations among the LSPE constructs, all were significantly different from unity, supporting the discriminant validity between perceived teaching behaviors (Bagozzi & Kimmel, 1995).⁴

Application of the four-factor model of the BREQ to the PE context should be regarded as unacceptable based on the CFA results, $\chi^2(84) = 359.20$, $p = .001$, χ^2/df ratio =

4.28, CFI = .86, NNFI = .82, SRMSR = .10, RMSEA = .081, CI_{90} for RMSEA range = .073–.090. Modification indexes (MI) suggested that one item from the identified regulation factor (“I participate in PE because I get restless if I don’t participate in lessons regularly”) deviated from its original factor. Specifically, MIs suggested freeing a factor loading from the introjected regulation factor to this item. This cross-loading suggested the item content did not distinguish clearly between these two factors. In addition, the item was negatively worded and did not appear to tap an essential aspect of the identified regulation construct (e.g., participating in PE for attainment of personally relevant outcomes), because feelings of restlessness do not adequately reflect perceptions of identification. Because of these empirical and content issues, this item was excluded from subsequent analyses. MIs also revealed a large value associated with error covariance between two items from the external regulation factor (“I participate in PE because my friends/family members say I should,” and “I feel under pressure from my friends/family members to participate in PE”). Typically, the error terms for any pair of items are assumed to be uncorrelated. Researchers have remarked, however, that incorporating these error terms into CFA model does not undermine the factorial validity of the data obtained, but rather it provides a more realistic factorial representation of the observed data (Bentler & Chou, 1987). As a result, the error covariance between these two items was set to be free. The revised CFA for the BREQ approached the criteria for satisfactory fit proposed by Hu and Bentler (1999), $\chi^2(70) = 225.80, p = .001, \chi^2/df$ ratio = 3.23, CFI = .91, NNFI = .88, SRMSR = .074, RMSEA = .069, CI_{90} for RMSEA range = .057–.077.

Table 1 presents descriptive statistics, correlations, and Cronbach alpha coefficients for the averaged manifest

study variables. Although not presented in Table 1, skewness and kurtosis values for study variables ranged from $-.59$ to $.73$ and $-.87$ to $-.12$, respectively. Multivariate skewness ($6.44, p < .01$) and kurtosis ($149.40, p < .01$) estimates were significant, indicating some violations of assumptions normality. Monte-Carlo simulation studies have indicated that, under conditions of high nonnormality, parameter estimates are relatively stable, but tests of goodness-of-fit tend to be biased upward (Hoogland & Boomsma, 1998; Kline, 1998). This potential for an inflated goodness-of-fit chi-square can lead to an increased possibility of rejecting a well fitting model (Type I error). The higher the goodness-of-fit chi-square is, the greater the deviation can be from the actual covariance matrices and, hence, a worse fit. This will yield lower incremental fit indexes (CFI, NNFI), leading the researcher to potentially reject or modify a well fitting model. As a consequence, researchers recommended using a scaling procedure that offers more robust estimates of model fit (Satorra & Bentler, 1988). Therefore, in the present study we reported the robust estimates to minimize potential inflation of fit indexes due to multivariate nonnormality. Specifically, Satorra and Bentler’s (1988) robust scaled chi-square value, as well as the Robust CFI (RCFI), was calculated.

Alpha coefficients ranged from .60 to .89. Alphas below the minimum criterion of .70 (Nunnally, 1978) for autocratic behavior, teaching and instruction, and positive and negative nonverbal feedback may be due to the relatively small number of items in the subscales (i.e., three). Because the alpha coefficient for these scales exceeded .60, identified by others as an acceptable reliability level for subscales with few items, and demonstrated a satisfactory underlying factor structure in the CFA (e.g., Amorose & Horn, 2000), these subscales were retained.

Table 1. Descriptive statistics and correlations among study variables

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Democratic behavior	(.80)										
2. Autocratic behavior	-.54*	(.60)									
3. Teaching and instruction	.60*	-.44*	(.64)								
4. Situation consideration	.69*	-.53*	.64*	(.79)							
5. Positive general feedback	.55*	-.34*	.45*	.56*	(.74)						
6. Positive nonverbal feedback	.48*	-.24*	.30*	.40*	.57*	(.64)					
7. Negative nonverbal feedback	-.35*	.46*	-.25*	-.35*	-.19*	.01	(.68)				
8. Competence need satisfaction	.16*	-.16*	.19*	.24*	.34*	.17*	-.16*	(.87)			
9. Autonomy need satisfaction	.57*	-.28*	.35*	.45*	.51*	.44*	-.17*	.27*	(.89)		
10. Relatedness need satisfaction	.22*	-.11*	.17*	.22*	.30*	.25*	-.01	.25*	.30*	(.89)	
11. Self-determination index	.44*	-.49*	.47*	.51*	.44*	.26*	-.42*	.46*	.31*	.25*	(.81)
Mean	2.89	2.34	3.38	3.35	3.17	2.57	2.25	3.77	2.61	4.70	3.76
Standard deviation	1.04	.81	.81	.97	.95	.93	.98	.90	.91	1.39	3.79

Note. All variables were measured on a 5-point scale, with the exception of the relatedness need satisfaction variable, which was measured on 7-point scale. Cronbach alphas for each subscale are presented on the diagonal in parentheses.

* $p < .01$.

As shown in Table 1, students' mean scores were slightly above the midpoint for all variables, with the exception of democratic and autocratic behavior, positive and negative nonverbal feedback, and autonomy need satisfaction scales. An inspection of the correlation revealed that all relationships were in the expected direction. For example, perceived competence, autonomy, and relatedness needs satisfaction were all significantly and positively associated with SDI. In addition, all seven perceived teaching behaviors were significantly and positively related to SDI, with the exception of autocratic behavior and negative nonverbal feedback that had significant and negative association with SDI, as expected.

Path Analysis

We used path analysis to test the hypothesized relationships between self-determined motivation and perceived teaching behaviors, needs for competence, autonomy, and relatedness (see Figure 1). The input covariance matrix was based on the correlation matrix presented in Table 1. The hypothesized model exhibited poor data fit, accounting for a 25% variance in self-determined motivation and 11%, 32%, and 7% variance in perceived competence, autonomy, and relatedness needs satisfaction, respectively, Satorra-Bentler $\chi^2(20) = 218.57, p = .001$, Satorra-Bentler χ^2/df ratio = 10.93, RCFI = .89, NNFI

= .69, SRMSR = .10, RMSEA = .14, CI_{90} for RMSEA range = .13–.16. Thus, we tested an alternative model in which direct paths from all dimensions of perceived teaching behaviors on self-determined motivation were specified as free parameters. The MIs also suggested adding one path, namely positive general feedback → autonomy need satisfaction. Statisticians have warned against indiscriminate use of MIs to modify models, as it capitalizes on chance to improve model fit. They suggested such modification should be included only when there is a clear theoretical basis for it (Diamantopoulos & Sigauw, 2000). Therefore, we evaluated the additional path on this basis. Including the positive general feedback → perceived autonomy need is consistent with SDT (Deci & Ryan, 1985, 2000), as positive feedback is generally interpreted as supporting the need for autonomy and has been shown to be linked with autonomous motivation (Vallerand, 1983). As a result, this path was a free parameter in the alternative model, which exhibited satisfactory fit with the data, Satorra-Bentler $\chi^2(12) = 23.40, p = .025$, Satorra-Bentler χ^2/df ratio = 1.95, RCFI = .99, NNFI = .98, SRMSR = .021, RMSEA = .044, CI_{90} for RMSEA range = .015–.070). The standardized path coefficients for the free parameters are shown in Figure 2. The model accounted for a 50% variance in self-determined motivation and 13%, 38%, and 9% variance in perceived competence, autonomy, and relatedness needs satisfaction, respectively.

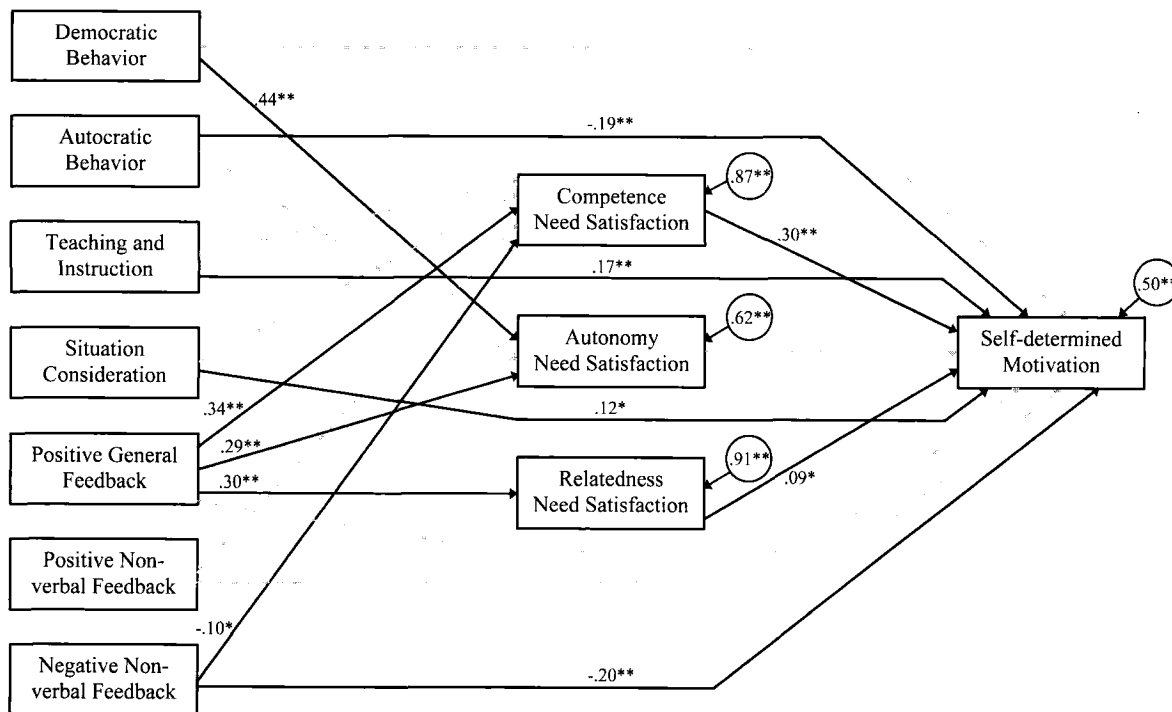


Figure 2. Path analysis showing relations between perceived teaching behaviors, satisfaction of psychological needs for competence, autonomy, and relatedness, and self-determined motivation in physical education. (Note. All path coefficients are standardized. The broken lines indicate nonsignificant paths. For clarity, the error covariances among perceived competence, autonomy, and relatedness need satisfaction variables are omitted. Covariances of the error terms were: $r_{\text{competence-autonomy}} = .12$, $r_{\text{autonomy-relatedness}} = .12$, $r_{\text{competence-relatedness}} = .16$. * $p < .05$, ** $p < .01$.)

Results indicated that perceived satisfaction of competence ($\beta = .30, t = 8.43, p < .01$) and relatedness ($\beta = .09, t = 2.51, p < .05$), as expected, had significant positive effects on students' self-determined motivation. Perceived autonomy, however, did not predict students' self-determined motivation in PE. Consistent with hypotheses, perceived democratic behavior ($\beta = .44, t = 9.38, p < .01$) positively predicted students' autonomy. However, the indirect effect of perceived democratic behavior on self-determined motivation was not significant. Perceived negative nonverbal feedback ($\beta = -.10, t = -2.24, p < .05$) had a significant negative effect on perceived satisfaction of competence, as expected. The indirect effect of perceived negative nonverbal feedback on self-determined motivation was small and borderline in significance ($\beta = -.03, t = -1.87, p = .062$). However, there was significant direct and negative effect of perceived negative nonverbal feedback ($\beta = -.20, t = -5.21, p < .01$) on self-determined motivation.

Significant positive effects of perceived positive general feedback on competence ($\beta = .34, t = 5.97, p < .01$), autonomy ($\beta = .29, t = 6.73, p < .01$), and relatedness ($\beta = .30, t = 6.89, p < .01$) emerged. Furthermore, the indirect effect of perceived positive general feedback ($\beta = .11, t = 4.23, p < .01$) on self-determined motivation was significant. The motivation hypothesis was tested according to the Baron and Kenny (1986) report, that four criteria must be satisfied to support mediation: (a) the dependent variable should be correlated with the independent or predictor variable, (b) the mediator should be correlated with the independent variable, (c) the mediator should have a significant unique effect on the dependent variable when included with the independent variable in a multivariate test, and (d) the effect of the independent variable on the dependent variable should be significantly attenuated or nullified when the mediator is an independent predictor of the dependent variable. To confirm the first two criteria, the zero-order factor correlations presented in Table 1 were examined. The third criterion was ascertained by examining whether the mediator had a significant direct effect on the dependent variable in the alternative model. Finally, to confirm the fourth criterion, the path from the mediator variable to the dependent variable was fixed to zero, and the model was reestimated. If the direct effect of the independent variable on the dependent variable was restored or increased, then complete or partial mediation would be confirmed.

To determine which variables were most responsible for the mediation, the effects of competence and relatedness needs were removed (i.e., fixed to zero) in an iterative fashion. That is, first the effect of perceived competence need was fixed to zero to examine the indirect effect of positive general feedback via the mediation of perceived relatedness need satisfaction. Then the effect of perceived relatedness was fixed to zero to examine the

indirect effect of positive general feedback via the mediation of perceived competence need satisfaction. Finally, both effects were fixed to zero to establish whether the direct effect of positive general feedback on self-determined motivation was restored.

Separate tests demonstrated that perceived satisfaction of competence was most responsible for the mediation between positive general feedback and self-determined motivation. In particular, tests revealed the larger indirect effect of positive general feedback ($\beta = .09, t = 3.81, p < .01$) via perceived competence after removing relatedness as a mediator, relative to the indirect effect of positive general feedback on self-determined motivation ($\beta = .04, t = 2.48, p < .05$) via perceived relatedness after removing perceived competence as a mediator. Overall, the tests revealed the direct significant effect of perceived positive general feedback ($\beta = .19, t = 3.79, p < .01$) equated to the total effect of positive general feedback on self-determined motivation ($\beta = .20, t = 4.11, p < .01$), with the exclusion of both paths from perceived satisfaction of competence and relatedness, indicating that complete mediation had occurred. Because perceived autonomy need satisfaction did not predict self-determined motivation, mediation for this variable was not tested.

Interestingly, perceived autocratic behavior, teaching and instruction, situation consideration, and positive nonverbal feedback did not affect any of the need satisfaction variables, contrary to expectations. These types of perceived teaching behaviors, however, showed significant direct effects on students' self-determined motivation, with teaching and instruction ($\beta = .17, t = 3.95, p < .01$) and situation consideration ($\beta = .12, t = 2.35, p < .05$) having a significant positive effect and autocratic behavior ($\beta = -.19, t = -4.52, p < .01$) having a significant negative effect. The only exception was the positive nonverbal feedback variable that did not significantly predict self-determined motivation.

Discussion

The main purpose of the present study was to test the prediction of SDT (Deci & Ryan, 1985, 2000) that the relationships between specific perceived teaching behaviors and students' self-determined motivation in PE are mediated through the need for competence, autonomy, and relatedness. Results indicated that satisfying the psychological needs for competence and relatedness, but not autonomy, were related to students' self-determined motivation. Apart from the lack of a significant relationship between autonomy and self-determined motivation, this supported one of the central tenets of SDT (Deci & Ryan, 1985, 2000), which was corroborated by others in a PE (Ntoumanis, 2001, 2005; Standage et al., 2003, 2006) and sport setting (Hollebeak & Amorose, 2005). That

is, people are motivated to engage in activities that satisfy their basic psychological needs. It is worth noting that the mean score for students' perceptions of autonomy was relatively low in the present study relative to the scale midpoint (i.e., 3), which is not a unique finding, as low levels of perceived autonomy in PE were reported previously (Ntoumanis, 2001). Ntoumanis (2001) claimed that PE teachers are usually required to follow a prescriptive curriculum that does not allow them to provide much choice and opportunities for students' initiatives. Therefore, the resulting controlling style will likely lead to decreased student perceptions of autonomy in PE. This is probably the case in Estonia and may explain the relatively low levels of students' perceptions that their teacher satisfied their need for autonomy. It is also possible that PE teachers do not feel really skilled in using supportive instructional behaviors (e.g., listening to students and asking what they want, providing rationale for activities, and being responsive to questions) that, according to Reeve and Jang (2006), support students' feelings of autonomy.

Turning next to the hypothesis that satisfying basic psychological needs would mediate the effects of various perceived teaching behaviors on students' self-determined motivation in PE (Deci & Ryan, 1985, 2000; Ryan & Deci, 2002), path analytic models revealed both direct and indirect effects. This indicated that the mechanisms affecting students' motivation in PE might vary. The pattern of relationships proposed by SDT (Deci & Ryan, 1985, 2000) was supported only for perceived teaching behaviors, such as positive general feedback. Specifically, the more students perceived their teacher provided positive feedback (i.e., praise and encouragement) the more they felt their needs to be competent, autonomous, and related to their classmates were satisfied; in turn, their reasons to participate in PE were more self-determined. This was not entirely consistent with the Hollembeak and Amorose (2005) study in which coaches' positive feedback had detrimental effects on college-age athletes' perceived competence. A contributing factor to this difference in findings could be the participants' age. Research has indicated that younger children believe in and rely more heavily on adult feedback when determining their athletic competence and this declines with age as their reliance on other sources, such as performance outcomes, personal statistics, learning, goal achievement, and so on, increase (Weiss, Ebbeck, & Horn, 1997).

Although we hypothesized perceived positive general feedback would be positively related to all three need satisfaction variables in PE, only perceptions of competence and relatedness mediated the relationship between perceived teacher's positive general feedback and self-determined motivation. Results further specified that perceived satisfaction for competence was most responsible for the mediation. This result was similar in previous studies (e.g., Vallerand & Reid, 1984) and one in a PE context (Hein &

Koka, 2007) that found a significant effect of positive feedback on perceived competence, which, in turn, positively predicted intrinsic motivation. This literature suggests the effects of feedback on self-determined motivation is mediated through competence need satisfaction. This is not surprising, as feedback generally relates to information about skill and aptitude rather than choice and rationale, which would represent an autonomy-mediated route to enhancing self-determined motivation. The present results, therefore, supported SDT (Deci & Ryan, 1985, 2000) in that feedback is primarily involved in a competence-mediated route to self-determined motivation.

This study, however, adds to the PE literature, because it tested the role of all three psychological needs in mediating the teacher's positive general feedback on students' self-determined motivation. We found that positive general feedback shared variance with autonomy need satisfaction. However, this had no concomitant effect on self-determined motivation. This was the only posteriori effect included in the model on the basis of the modification indexes, because it was theoretically viable to include this path according to previous research (Vallerand, 1983). It is possible the generalized feedback versions may contain rationale and choice components that might be related to autonomous motivation. Future research would need to identify the general feedback components that contribute specifically to autonomy need support. The model also illustrated the importance of relatedness, albeit marginal, in the mediation process in addition to competence. It is not surprising that positive feedback is associated with the need for relatedness, given that it illustrates generally supportive statements from a significant other and points toward the complementary effect of psychological needs on self-determined motivation (Hagger et al., 2006).

Further, the present study revealed interesting and unexpected results, showing that perceived behaviors of teaching and instruction, situation consideration, autocratic behavior, and negative nonverbal feedback had significant, direct effects on students' self-determined motivation, unmediated by the need satisfaction variables. These results deviated from SDT tenets (Deci & Ryan, 1985, 2000) and the Hollembeak and Amorose (2005) study results. Possible reasons for this deviation follow.

First, the relative significance of satisfying psychological needs could be different in PE and collegiate competitive sport. Research has shown that young sport participants involved at competitive and elite levels of sport had significantly higher perceived competence than those who were involved at the basic level (i.e., PE lessons only, family recreation, informal, and noncompetitive sport; Van Wersch, 1997). Hence, the desire to feel and demonstrate physical competence might be higher for those who participate in competitive sport, compared to those whose sport experience is limited to PE lessons, for instance. Although theoretical and empirical evidence

highlights the importance of perceived competence in both achievement settings, children participating in PE perhaps do not consider physical competence as important as youngsters participating in competitive sport. Bearing this in mind, one may argue that the role of psychological need satisfaction, such as perceived competence as a mediator between certain perceived instructional behaviors and self-determined motivation, is different in competitive sport and PE.

Another possible reason for the significant direct effects on students' self-determined motivation, unmediated by competence and autonomy, could be that the teaching behaviors failed to convey substantial competence information or facilitate feelings of autonomy. The only essential antecedent of self-determined motivation through competence for the current sample was the teacher's positive general feedback.

The present study, however, suggested that students were more self-determined in their motivation toward PE when they perceived more frequent teaching and instruction and situation consideration behavior but less frequent autocratic behavior and negative nonverbal feedback from their teachers. Previous studies in sport demonstrated similar results, in which changes in athletes' intrinsic motivation were associated with the degree they perceived their coaches engaged in frequent training and instructional behavior and infrequent autocratic behavior (Amorose & Horn, 2000). It is also possible that the significant direct effect of teaching behaviors may have reflected a more spontaneous route to students' self-determined motivation toward PE (Hagger et al., 2006). These teaching behaviors may not have been part of a deliberative, motivational process but more impulsive, implicit processes (Burton, Lydon, D'Alessandro, & Koestner, 2006). Future research should measure implicit motives and establish whether they are more effective as a mediator of these effects (Hagger & Chatzisarantis, 2008).

Although the present study provided interesting and unique information about the relationships between perceived teaching behaviors, psychological needs, and self-determined motivation among secondary school students in Estonia, one must be cautious about generalizing the present findings. A limitation of the current study involves its cross-sectional design, which precluded the inference of causality. This limitation applies to all cross-sectional studies in the field, but sufficient attention has not been paid to such limitations (Andersen, McCullagh, & Wilson, 2007; Hagger & Chatzisarantis, 2009). It is possible that students' motivational orientation may affect the way teachers behave, as suggested by Pelletier and colleagues (Pelletier, Séguin-Lévesque, & Legault, 2002). Thus, longitudinal study designs are needed to better infer the causal nature of the proposed relationships. Further, longitudinal studies are needed to examine the stability of the pattern of relationships between different types of

perceived teaching behaviors, psychological need satisfaction, and self-determined motivation among students over time to provide more robust support for these processes. Second, it is possible that children of different ages may differ in preferred teaching behaviors. Chelladurai and Carron (1983) found evidence of this trend in instructional/coaching situations. Future studies should examine the effects tested in the present study among students in different age groups.

Conclusions and Recommendations for Practice

A unique contribution of the present study was identification of the possible mechanism behind the relationship between specific perceived teaching behaviors and students' self-determined motivation in PE by testing central SDT tenets (Deci & Ryan, 1985, 2000). The findings revealed that not all dimensions of teachers' interpersonal contexts had implications for students' self-determined motivation in PE through psychological needs satisfaction as predicted by SDT.

From an applied perspective, teachers should focus on the behaviors that had a significant impact on students' self-determined motivation in PE (i.e., positive general feedback, teaching and instruction, situation consideration, negative nonverbal feedback, and autocratic behavior). By adopting a teaching style that emphasizes improving students' performance while considering their ability levels and praising and encouraging their efforts, teachers may increase students' self-determined motivation toward PE. In addition, to acknowledge the benefit of participating in activities for more self-determined reasons (Ntoumanis, 2001, 2005; Standage et al., 2003, 2005) PE teachers should avoid negative gestures in response to a poor performance and avoid adopting a rigid decision-making style, as these behaviors tend to decrease students' self-determined motivation toward PE.

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- motivation. Integrated regulation refers to behaviors that are performed out of choice to bring coherence to different parts of the self. It has been argued that this type of motivation is more often encountered in older adolescents and adults rather than children, as they may be too young to experience a sense of integration within the self (Vallerand, 2007). Therefore, we did not elaborate on or assess integrated regulation in this study.
2. Past research in physical education (Ntoumanis, 2001; Standage et al., 2005) based on self-determination theory demonstrated the invariance of motivational models across gender. Therefore, data from boys and girls were pooled in the current study.
3. The current study omitted positive feedback from the Revised Leadership Scale for Sport (Zhang et al., 1997), because it overlaps with the perceived positive general feedback measure from the Perceptions of the Teacher's Feedback questionnaire (Koka & Hein, 2005).
4. Preliminary analysis demonstrated that correlations among the Leadership Scale for Physical Education (LSPE) constructs were significantly different from unity supporting discriminant validity of the constructs, except for social support factor. With regard to social support, the difference between unity and correlation values with other LSPE constructs did not exceed 1.96 multiplied by the standard error of the correlation, indicating the lack of discriminant validity (Bagozzi & Kimmel, 1995). As a result, social support was excluded from subsequent analyses. Social support refers to the extent the teacher is involved in satisfying students' interpersonal needs and demonstrates interest and concern for the students' well being (an example is "My PE teacher stays interested in the personal well being of the students in the lessons").

Authors' Notes

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Notes

1. Self-determination theory (Deci & Ryan, 1985, 2000) also embraced integrated regulation as a type of extrinsic