Perceptions of teachers' interpersonal styles and well-being and ill-being in secondary school physical education students: The role of need satisfaction and need frustration

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Abstract

This study examined the associations among physical education students' perceptions of their teachers' autonomy-supportive and controlling interpersonal styles, need satisfaction and need frustration, and indices of psychological well-being (subjective vitality) and ill-being (negative affect). The results from 591 Chinese secondary school students in Hong Kong indicated that the relationship between students' perceptions of autonomy-supportive teaching behaviors and subjective vitality was primarily mediated by need satisfaction, whereas the relationship between perceived controlling teaching behaviors and negative affect was primarily mediated by need frustration. The results obtained from the multi-group structural equation model also suggested that these relationships were invariant across sex.

Keywords: autonomy-support, control, need satisfaction, need frustration, vitality, negative affect

Introduction

Physical education (PE) in schools is recognized as a principle vehicle for health promotion and a context in which reported reductions in physical activity levels can be addressed (Ntoumanis & Standage, 2009). A systematic review found strong evidence for the effectiveness of school-based PE in increasing levels of physical activity and improving physical fitness in children and adolescents (Kahn et al. 2002). However, recent studies have also revealed that students who have negative experiences in school-based PE and athletics may demonstrate a significant reduction in physical activity later in their lives (Cardinal, Yan, & Cardinal, 2013). Therefore, in order for teachers to successfully facilitate student engagement in PE, and encourage the internalization of physical activity behaviors associated with lifelong health, it is vital that they not only focus on improving skill mastery and physical fitness, but also pay attention to the subjective experiences of their students during each lesson. Surprisingly however, few studies have investigated the way in which both positive and negative social factors relate to the experiences of students in the context of PE. The primary social influence in the PE setting is the teacher and, therefore, the way in which their interpersonal style influences both the positive and negative subjective experiences of their students clearly warrants further study. To this end, the present study adopted self-determination theory (*SDT*; Deci & Ryan, 1985; Ryan & Deci, 2017) as a framework to examine the relations between student perceptions of their teachers' interpersonal styles, the satisfaction and frustration of their psychological needs, and their psychological well- and ill-being in PE.

According to the basic psychological need theory (BPNT; Deci & Ryan, 2000), a subtheory within SDT, human beings have inherent tendencies towards growth and optimal functioning, however, this positive potential is only actualized under certain environmental conditions (Vansteenkiste & Ryan, 2013). Specifically, social contexts can either support or

thwart an individual's perception of three basic psychological needs, namely autonomy, competence, and relatedness; this in turn leads to adaptive or maladaptive psychological functioning, also known as psychological well- or ill-being, respectively (Ryan & Deci, 2000). Autonomy refers to the need for self-governance and self-endorsement of one's own behavior (Ryan & Deci, 2006). Competence is defined as feeling effective in ongoing interactions with the social environment as well as having the opportunities to express one's capabilities (Deci, 1975; White, 1959). Finally, relatedness refers to feeling connected to others, caring for and being cared for by others, and maintaining a sense of belonging (Ryan, 1995). When these needs are satisfied, individuals feel autonomous in their actions, competent in their activities, and connected to others in their environment. By contrast, when their needs are thwarted, individuals may experience pressure, feelings of inferiority and failure, and loneliness and alienation (Bartholomew, Ntoumanis, Ryan, & Thøgersen-Ntoumani, 2011).

Therefore, need frustration has been proposed to be distinct from the absence of need satisfaction (Bartholomew et al., 2011; Vansteenkiste & Ryan, 2013). This important conceptual differentiation has practical significance as it suggests that experiences of need satisfaction and need frustration may have separate antecedents and relate to different well- and ill-being outcomes (Bartholomew, Ntoumanis, Ryan, Bosch, & Thøgersen-Ntoumani, 2011). In general, social factors may support the three basic psychological needs (need support), which in turn leads to experiences of need satisfaction, and in turn elicit more optimal functioning or well-being. This process is considered a "bright" pathway toward human development. In contrast, social factors may thwart the three needs (need thwarting), which leads to need frustration and activate a "dark" pathway toward non-optimal functioning or ill-being (Ryan & Deci, 2000; Vansteenkiste & Ryan, 2013).

Teachers are an important social factor in the educational context and the method by

which teachers interact with their students in teaching-related activities can be referred to as their interpersonal style (Reeve, 2009). Initial research in this area suggested that the interpersonal style of a teacher could be conceptualized along a continuum that ranges from highly autonomy-supportive to highly controlling (Deci, Schwartz, Sheinman, & Ryan, 1981). The key characteristics of an autonomy-supportive interpersonal style include providing students with choices and opportunities for initiating activities (Mouratidis, Vanteenkiste, Lens, & Sideridis, 2011), displaying a sincere interest in student preferences, actively listening to students, acknowledging student perspectives and difficulties (Jang, Reeve, & Deci, 2010), and providing meaningful rationales for activities (Jang, 2008). In contrast, the characteristics of a controlling interpersonal style include ignoring student perspectives, pressing students to think and act in particular ways (Soenens, Sierens, Vansteenkiste, Goossens, & Dochy, 2012), using strict standards (e.g., opinions and values) as a reference, and making the students feel that they having no choice but to comply with the instructions of their teachers (Reeve, 2009).

More recent research has questioned whether it is right to view these two constructs as sitting on a continuum and, therefore, antipodal (Bartholomew, Ntoumanis, & Thøgersen-Ntoumani, 2009; 2010; Pelletier, Fortier, Vallerand, & Briere, 2001; Tessier, Sarrazin, and Ntoumanis, 2008). For instance, Tessier et al. (2008) argued that autonomy-supportive and controlling interpersonal styles should be considered as two independent constructs because, for example, a low level of autonomy-supportive interpersonal behaviors does not suggest, by definition, a high level of controlling interpersonal behaviors. Recent research has shown that autonomy support and control can co-occur, so that different combinations of both styles can be identified. This work shows that teachers (and coaches) can be perceived as high on autonomy support and low on control, low on autonomy support and high on control, high on both styles, or low on both styles (Amoura, Berjot, Gillet, Caruana, Cohen, & Finez, 2015;

Haerens et al., in press; Matosic & Cox, 2014). Furthermore, the absence of autonomy support may be displayed as a "neutral" style that does not reflect the will to control others. Evidence from athletic and PE contexts has suggested that perceptions of autonomy support provided by coaches or teachers is only moderately correlated with perceptions of their controlling behavior (rs = −.37 to −.51; Bartholomew et al., 2011). Recently, Vansteenkiste and Ryan (2013) further clarified the differences between autonomy-supportive and controlling interpersonal styles by illustrating that the social context can actively foster, be indifferent to, or be antagonistic toward the satisfaction of individual needs. An interpersonal style characterised by high levels of autonomy support should actively support experiences of need satisfaction. Low levels of autonomy support may represent a more passive and indirect influence on need satisfaction whereas a controlling interpersonal style is likely to involve a more active and direct means of frustrating psychological needs (De Meyer et al., 2014; Haerens, Aelterman, Vansteenkiste, Soenens, & Van Petegem, 2015). Whilst this assertion is becoming increasingly accepted in the SDT literature, research conducted to date has primarily focused on adaptive teaching dimensions and their beneficial effects on students' psychological needs and outcomes (Taylor & Lonsdale, 2010; Vlachopoulos, Katartzi, & Kontou, 2011); far fewer studies have also directly assessed controlling teaching behaviors and their potentially negative consequences (Assor, Kaplan, Kanat-Maymon, & Roth, 2005; Hein, Koka, & Hagger, 2015). This recent clarification of the relationship between the two interpersonal styles indicates the critical nature of further research exploring how autonomy-supportive and controlling behaviors relate to each other and to the psychological well- and ill-being of students.

Different approaches have provided a variety of definitions of psychological well-being. For example, the hedonic view of well-being focuses on what makes experiences and life overall pleasant or unpleasant. This approach is more concerned with the attainment of

happiness and pleasure and has therefore been criticized as being limited in scope (Stebbings, Taylor, Spray, & Ntoumanis, 2012). In contrast, the eudemonic view of well-being, which has been widely used in SDT studies, is concerned with psychological flourishing through ongoing efforts to achieve individual potential and live in a meaningful and purposeful way (Lubans et al., 2016). The eudemonic approach is comprised of various aspects of feeling and functioning, such as emotional stability, optimism, positive emotions, and vitality (Huppert & So, 2013). High levels of well-being have been found to be associated with a variety of positive outcomes, such as effective learning (Huppert, 2009) and active engagement (Reeve, 2009). By contrast, low levels of well-being have been associated with poor physical health (Ryff, Singer, & Dienberg Love, 2004). Subjective vitality, an important indicator of the eudemonic view of well-being, has been widely used in SDT studies. It reflects the extent to which the individual feels alive and energetic in a particular context (Ryan & Frederick, 1997). Psychological ill-being was originally considered to be the opposite of psychological well-being (Bradburn, 1969). Research has, however, consistently demonstrated that the absence of psychological ill-being is no guarantee of the presence of high levels of psychological well-being (e.g., Keyes, 2002). Research in the field of biology has also provided support for this distinct hypothesis that well-being and ill-being are independent dimensions of psychological functioning with unique biological correlates (Ryff et al., 2006). Therefore, people may show high levels of both well-being and ill-being, which implies that well-being and ill-being are independent constructs with distinct antecedent and consequent variables (Ryff et al., 2006). Similarly, according to the hedonic approach, psychological ill-being is reflected not in the absence of positive affect, but the experience of negative affect (Watson et al., 2008). Clearly, psychological ill-being, as an independent construct from psychological well-being, deserves further study especially in the context of education.

The Present Study

Previous research has extensively examined the facilitating effect of teacher autonomy support on students' experiences of need satisfaction and positive outcomes, including increased well-being (Taylor & Lonsdale, 2010; Vlachopoulos et al., 2011). Furthermore, alongside examining this "bright" pathway, recent research has begun to explore how controlling teaching behaviors relate to negative student outcomes through experiences of need frustration (De Meyer et al., 2014; Haerens et al., 2015; Hein et al., 2015). These studies have demonstrated that need satisfaction and need frustration are separate experiential states that have different antecedents and outcomes. However, the small body of work which has incorporated measures of controlling teaching has focused primarily on its detrimental impact on student motivation. It is also important to explore the way in which autonomy-supportive and controlling interpersonal styles are associated with students' subjective well- and ill-being experiences (Cardinal et al., 2013).

In this regard, Bartholomew, Ntoumanis, Ryan, Bosch et al. (2011) tested the "dual-process model" (see Jang, Kim & Reeve, 2016) that incorporates both a "bright" pathway (i.e., from perceived coach autonomy-supportive to athlete well-being via need satisfaction) and a "dark" pathway (i.e., from perceived coach control to athlete ill-being via need frustration). As expected, need satisfaction strongly related to vitality and positive affect whereas need frustration better predicted disordered eating, burnout, and depressive symptoms. Similar findings in relation to well- and ill-being have been obtained in contexts such as work (Gillet, Fouquereau, Forest, Brunault, & Colombat, 2012) and health (Verstuyf, Vansteenkiste, Soenens, Boone, & Mouratidis, 2013).

Whilst these studies provide support for the practical importance of theoretically distinguishing between autonomy-supportive and controlling behaviors, and experiences of need satisfaction and need frustration, in relation to understanding both optimal and non-optimal psychological functioning in various domains, no research in PE has tested the dual

process model in relation to student well- and ill-being. The main aim of the present study is to extend previous research by testing a theory-based model encompassing autonomy-supportive and controlling interpersonal styles, satisfaction and frustration of psychological needs, and psychological well-being (subjective vitality) and ill-being (negative affect) in the context of PE (Figure 1). In line with SDT and previous research findings, it was hypothesized that perceived autonomy support from teachers would be primarily associated with students' feelings of subjective vitality through need satisfaction, whereas perceived controlling behavior would be primarily associated with student experiences of negative affect through psychological need frustration. We also expected to find a modest negative relation between perceptions of teachers' autonomy-supportive and controlling interpersonal styles. SDT suggests that the three psychological needs are universal and the means through which they are satisfied or thwarted may vary in different groups, however most SDT-based research has suggested that controlling teaching behaviors are equally harmful for girls and boys (Assor et al., 2005). Therefore, the relationships among variables were expected to be invariant across male and female students in this study.

Methods

Participants

A convenience sample of 623 Chinese students from 18 classes (grades 7–10) in four government and government-aided secondary schools in Hong Kong were invited to participate in this study and 606 students completed the questionnaires. Seventeen students out of 623 were absent from the study because of special reasons (e.g., sickness). Excluding the incomplete data, data from 591 students out of 606 were identified as valid data for analysis. The participants were aged between 11 and 17 years (M = 13.69, SD = 1.24); 306 were boys and 285 were girls. All students could read and speak Chinese.

Procedure

Ethical approval was obtained from a local University Human and Animal Research Ethics Committee. The principals and PE teachers of the four secondary schools were contacted and provided with information on the study to obtain permission to collect data. With this approval, written informed consent was obtained from the students and their parents prior to data collection. Participants were informed prior to data collection that the anonymity and confidentiality of their answers would be preserved at all times. The administrator responsible for data collection emphasized that the purpose of the questionnaire was to measure the general feelings of the participants towards PE. All participation in this study was voluntary. Participants completed the questionnaires at the end of their PE classes about their experiences with their teacher during the past lesson. Questionnaires were completed in the absence of their teachers. It took about 10 minutes to complete the questionnaire.

Measures

Perceived autonomy support. The six-item Health Care Climate Questionnaire (HCCQ; Williams, Grow, Freedman, Ryan, & Deci, 1996) was used to measure students' perceptions of autonomy support provided by the teacher in their PE class. An example item from the original HCCQ is: "I feel that the staff has provided me with choices and options." The wording of the items was changed slightly to suit the PE context. An example of a revised item is: "I feel that my PE teacher provides me with choices and options." Responses were provided using a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The Chinese version of the revised scale has been used in previous studies among Chinese populations and demonstrated good internal consistency reliability in a previous study ($\alpha = .91$; Liu & Chung, 2015) and the current study (composite reliability = .84).

Perceived controlling behaviors. The six-item Chinese version of the Psychological Control in Teaching scale (Soenens et al., 2012) was used to measure the extent to which

students' perceived their PE teacher to engage in controlling behaviors. An example item is: "I feel that my PE teacher is always trying to change me." Responses were provided using a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The internal consistency of the scale has been supported in previous research (α = .80; Soenens, et al., 2012). The Chinese version of the questionnaire demonstrated acceptable internal consistency reliability in the current study (composite reliability = .73).

Psychological needs satisfaction. The Psychological Needs Satisfaction Scale in Physical Education (Liu & Chung, 2014) was used to assess the need satisfaction of students in PE classes. The questionnaire was developed in Chinese and includes 10 items which measure three factors: satisfaction of autonomy, competence, and relatedness. Example items include: "I have opportunities to express my views and thoughts in my physical education classes"; "I have the ability to perform well in my physical education classes"; and "I get along well with the people in my physical education classes." Responses were provided using a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The subscales demonstrated good internal consistency reliability in a previous study (composite reliability: autonomy = .82, competence = .83, relatedness= .84; Liu & Chung, 2014) and the current study (composite reliability: autonomy = .81, competence = .83, relatedness= .85).

Psychological needs frustration. The Psychological Needs Thwarting[1] Scale in Physical Education (Liu & Chung, 2015) was used to assess the need frustration of students in PE classes. This scale was developed based on the Psychological Need Thwarting Scale originally developed for use in sport (Bartholomew, Ntoumanis, Ryan & Thøgersen-Ntoumani, 2011). The Chinese version of the scale includes nine items and measures three factors: frustration of autonomy, competence, and relatedness. Example items include: "I feel pushed to behave in certain ways in my physical education classes"; "There are situations in which I am made to feel inadequate in my physical education classes"; and "I feel some

people in my physical education classes do not like me much." Responses were provided using a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The subscales demonstrated good internal consistency reliability in a previous study (composite reliability: autonomy = .82, competence = .80, relatedness= .84; Liu & Chung, 2015) and the current study (composite reliability: autonomy = .82, competence = .79, relatedness = .83).

Subjective vitality. A six-item Chinese version of the Subjective Vitality Scale (SVS; Ryan & Frederick, 1997) was employed to measure the subjective vitality of students. An example item is: "I feel alive and full of energy." Reponses were provided using a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The scale was found to have good internal consistency reliability in a previous study (composite reliability = .87; Liu & Chung, 2014) as well as in the current study (composite reliability = .88).

Negative affect. A five-item Chinese version of the Negative Affect Subscale from the International Positive and Negative Affect Schedule Short Form (Thompson, 2007) was used to measure the negative affect of students as an indicator of subjective ill-being. Reponses were provided using a 5-point Likert scale ranging from 1 (*never*) to 5 (*always*). The scale was found to have good internal consistency reliability in a previous study (composite reliability = .85; Liu & Chung, 2014) as well as in the current study (composite reliability = .85).

Data Analysis

Due to the fact that the students in this study were nested within 18 classes, intra-class correlations (ICCs) for all variables were calculated to estimate the "class-level" effects (Raykov, 2011). The ICCs of variables were found less than .10 (ranged from .015 to .091). Therefore, we treated the data as a whole and didn't take the between-class variances into consideration in the subsequent analyses.

Data were analysed using structural equation modelling (SEM) with maximum-likelihood estimations. All analyses were carried out using AMOS 18.0 (SPSS Inc., Chicago, IL). In line with the frequently advocated two-step approach to SEM (Kline, 2011), the first stage of our procedure was to check the overall measurement model. Once the measurement model was deemed acceptable, the second step was to test whether the data provided an adequate fit to the hypothesized model. The ages of students were controlled to eliminate the influence of this variable on the results throughout all analyses.

To increase the stability of the parameter estimates, a parceling technique (cf. Little, Cunningham, Shahar & Widaman, 2002) that has been used in previous studies that have tested similarly complex models (e.g., Standage, Gillison, Ntoumanis, & Treasure, 2012) was used. Little et al. (2002) suggested that if the analysis is intended to improve understanding of the relations among constructs instead of that among items, parceling is more strongly warranted. Therefore, in this study, construct-specific parcels were created for the variables of autonomy support, perceived control, subjective vitality, and negative affect. Each parcel represented un-weighted average scores created by pairing stronger loading items with weaker loading items from the same scale (Little et al., 2002). In line with previous SDT-based research (Bartholomew et al., 2011), the three need-satisfaction subscales and the three need-frustration subscales were used as indictors of latent variables for general need satisfaction and general need frustration, respectively.

AMOS only provides a bootstrapping test for the sum of the multiple mediator effects and does not provide a test for each mediator. Therefore, to estimate the indirect effects of autonomy-supportive and controlling interpersonal styles through need satisfaction and need frustration, respectively, on subjective vitality and negative affect, the phantom latent model approach was used (Macho & Ledermann, 2011). This approach was originally proposed by M. W. L. Cheung (2007) to estimate and compare specific effects in a model. The application

of the approach in AMOS was introduced by Macho and Ledermann (2011). According to this method, a phantom variable (latent variable) is added to the model as an extra variable and exerts a direct effect on one of the main variables. The variance of this phantom variable is fixed as zero, and the structural coefficient assigned to the path from the phantom variable to the main variable is restricted by a formula representing the specific effect or a contrast between two or more effects. This strategy forces the program to provide estimates and standard errors for the structural coefficient represented by the formula. An additional phantom variable with fixed variance and a direct effect constrained as a function of the other model parameters will not influence the estimation of parameters for the model (Macho & Ledermann, 2011). Multiple goodness-of-fit indices were used to evaluate the model fit, such as the chi-square statistic (χ^2), the comparative fit index (CFI), the root mean square error of approximation (RMSEA) at a 90% confidence interval (90% CI), and the standardized root mean square residual (SRMR). Values ≤ .08 and .06 (respectively) for RMSEA and SRMR advocate a model with acceptable fit to the data (Hu & Bentler, 1999). A CFI value > .90 indicates adequate model fit and a value > .95 is the benchmark for models with excellent fit (Hu & Bentler, 1999).

Multiple group SEM analysis was used to examine the invariance of the structural model across sex. Specifically, two increasingly constrained models that specifically examined measurement (i.e., measurement weights) and structural parameters (i.e., structural weights) were tested for equality across groups (Byrne, 2010). Traditionally, invariance testing has relied on the χ^2 test statistic as an indicator of equality across groups. Because this test is influenced by sample size, the CFI difference approach recommended by G. W. Cheung and Rensvold (2002) was also used in this study. Accordingly, the change in the CFI value of < .01 between increasingly constrained models is considered indicative of model invariance.

Results

Table 1 presents the means, standard deviations, and interfactor correlations of all measures. Examination of Mardia's coefficient (112.83, p < .001) indicated that the data departed from multivariate normality. Subsequently, following the recommendations of Byrne (2010), all analyses were conducted using maximum-likelihood estimation coupled with bootstrapping procedures. In accordance with Preacher and Hayes (2008), this study used 5,000 bootstrap samples, with replacements based on the original sample. Examination of the measurement model showed that it had an acceptable fit to the data: χ^2 (129) = 487.55, $p < .001$; CFI = .94; RMSEA = .07 (90% CI = .06–.08); SRMR = .05. All observed indicators loaded significantly ($p < .01$) on their assigned latent construct, with factor loadings ranging between .61 and .88. Table 2 displays the means, standard deviations, standardized factor loadings, standardized error, and squared multiple correlations of observed indicators. Because the measurement model displayed an acceptable fit, the structural model was examined and also demonstrated an acceptable fit to the data: χ^2 (134) = 507.13, $p < .001$, CFI = .94, RMSEA = .07 (90% CI = .06–.08), SRMR = .05. The standardized path coefficients are presented in Figure 2.

The results revealed that autonomy support from teachers was significantly related to student need satisfaction ($\beta = .73$, $p < .01$) and need frustration ($\beta = -.12$, $p < .05$), whereas perceived controlling behavior was significantly correlated with need frustration ($\beta = .62$; $p < .01$) but not with need satisfaction ($\beta = -.02$, $p = .78$). These results indicated that autonomy support was primarily related to need satisfaction and perceived controlling behavior was primarily related to need frustration. Furthermore, need satisfaction displayed a significant positive correlation with subjective vitality ($\beta = .80$, $p < .01$) but not with negative affect ($\beta = -.02$, $p = .78$), whereas need frustration was significantly correlated with negative affect ($\beta = .71$, $p < .01$) and subjective vitality ($\beta = -.16$, $p < .01$). These results suggested

that need satisfaction was more strongly associated with subjective vitality, whereas need frustration was more strongly associated with negative affect.

The structural model explained 80.2% of the variance in subjective vitality and 49.2% of the variance in negative affect. The indirect effect of perceived autonomy support through need satisfaction on subjective vitality was .67 (BC 95% CI = .57–.79). The indirect effects of perceived autonomy support through need frustration on subjective vitality was .02 (BC 95% CI = .01–.05) and on negative affect was −.06 (BC 95% CI = −.12–−.01), respectively. The indirect effect of perceived controlling behavior through need frustration on negative affect was .36 (BC 95% CI = .28–.48) and on subjective vitality was −.12 (BC 95% CI = −.20–−.05). No indirect effects of perceived controlling behavior through need satisfaction were detected for either subjective vitality or negative affect and no indirect effect of perceived autonomy support through need satisfaction on negative affect neither. This is because the relationships of need satisfaction with controlling and negative affect were nonsignificant. Finally, perceived controlling behavior had a moderate negative association with autonomy support ($\beta = -.45$, $p < .01$).

The results of invariance analysis suggested that the independent SEM models specified for males and females displayed adequate fit to the data (Table 3). In multiple group SEM analysis, the unconstrained model (M1) displayed an acceptable fit to the data. When the measurement weights were constrained (M2) to be equal across sex, the model yielded a satisfactory fit to the data. When M2 was compared with M1, the χ^2 difference was not significant and the change in CFI was also < .01. The results supported the invariance of the measurement weights across sex. The final model (M3), which additionally constrained the structural weights to be equal across sex, maintained an adequate fit to the data. Further, when M3 was compared with M2, the χ^2 difference was not significant and the change in CFI was < .01. The results suggested that the structural weights were invariant across sex.

Collectively, the results of the invariance analysis suggested that the factor loadings and factor relationships of the structural model shown in Figure 2 were invariant across male and female students.

Discussion

The current study contributes to our understanding of how the interpersonal styles of teachers relate to the psychological well- and ill-being of their students by incorporating both need satisfaction and need frustration into one model. The present study expands on previous studies in several ways. First, to the best of our knowledge, this is the first study in a PE context that investigates the relationships between the interpersonal styles of teachers and the psychological well- and ill-being of their students from the perspectives of both need satisfaction and need frustration, although a similar approach has been employed in previous studies to investigate the relations between the interpersonal styles of teachers and the motivational outcomes of their students (Haerens et al., 2015). In particular, the findings emphasize the importance of assessing perceptions of interpersonal control and experiences of psychological need frustration, independently of autonomy-supportive behaviors and experiences of need satisfaction, if we are to understand why some students experience negative affect in PE. Fostering need-satisfying experiences in students is an important objective if PE is to be used successfully as a vehicle for PA promotion (Ntoumanis & Standage, 2009).

The different mediating effects of need satisfaction and need frustration in the relationship between the interpersonal styles of teachers and the psychological well- and ill-being of their students were also differentiated in this study. Consistent with the assumptions of SDT, the relationship between perceptions of teachers' autonomy-supportive interpersonal styles and the subjective vitality of their students was mediated by need satisfaction. In other words, when students reported higher levels of autonomy support from their teachers, they

experienced greater subjective vitality because their psychological needs for autonomy, competence, and relatedness were satisfied. This result is consistent with previous research which has examined the social-psychological antecedents of well-being in PE (Taylor, & Lonsdale, 2010) and other settings such as the workplace (Gillet et al., 2012) and health (Verstuyf et al., 2013) and athletic contexts (Bartholomew, et al., 2011). Notably, this study found that autonomy support also exerted a significant but weak indirect effect through need frustration on subjective vitality. This result suggests that students who report higher levels of autonomy support from their teachers experience less need frustration and, therefore, greater subjective vitality. Hence, it indicates that perceptions of autonomy-support can protect students against experiences of need frustration and help them maintain feelings of vitality in this context. A similar findings have also been reported in the workplace, namely need frustration mediated the relationship between autonomy support and work satisfaction and happiness (Gillet et al., 2012). However, previous studies in PE and athletic contexts have not found this mediating effect. Thus, whilst the present study provides support for the dominant mediating role of need satisfaction in the relationship between autonomy support and psychological well-being, the findings suggest that researchers should also further investigate the mediating role of need frustration in this relationship.

Second, the present study also found a significant indirect effect of controlling behavior through need frustration on psychological ill-being. This suggests that students who perceive more controlling behavior from their teachers experience more negative affect because their psychological needs are frustrated. For instance, those students who feel pressured into thinking and acting in particular ways, often at the expense of their own perspective, are likely to perceive themselves as controlled, incompetent, and alienated from their teacher. These feelings mediate the impact of controlling teaching behavior on feelings of negative affect. These findings are consistent with previous research in athletic

(Bartholomew et al., 2011) and educational contexts (Hein et al., 2015) and provide further evidence to support the limited research which has explicitly tested SDTs theoretical assumptions in relation to the "dark" pathway. An indirect effect of controlling behavior on negative affect through need satisfaction was not detected because the correlation between controlling behavior and need satisfaction was nonsignificant. This result is also consistent with previous findings from athletic contexts (Bartholomew et al., 2011). However, a recent study in a PE context did find that the controlling behavior of teachers was negatively associated with student need satisfaction (Haerens et al., 2015), which suggested that the use of controlling interpersonal styles by teachers will hinder student need satisfaction. More studies are needed to further examine the role of need satisfaction in this relationship.

Third, this study found that the controlling behavior of teachers had an indirect effect on the psychological well-being of students (subjective vitality) through need frustration. This result suggests that use of controlling interpersonal styles by teachers not only lead to experiences of psychological ill-being (negative affect) but are also detrimental to their psychological well-being. Similar results have also been reported in the workplace, namely need frustration mediated the relationship between the controlling behavior of superiors and employee happiness (Gillet et al., 2012). In contrast, research in athletics and PE has not found support for the indirect effect of controlling behavior on psychological well-being or autonomous motivation through need frustration (Haerens et al., 2015). Future studies in various fields should investigate the possible indirect effect of need frustration in this relationship.

Forth, teachers' autonomy-supportive interpersonal styles were found to have an indirect effect on students' psychological ill-being through need frustration. This result implies that the use of autonomy-supportive interpersonal styles by teachers had a buffering effect on the negative affect of their students through need frustration. Among students who

perceived the same level of controlling from their teachers, those who received higher autonomy support from teachers experienced less need frustration and less negative affect. Similar results were reported in a previous study of a young athlete population (Bartholomew et al., 2011). Overall these findings provide strong support for the role of need satisfaction and need frustration as underlying mechanisms via which perceived autonomy-supportive and controlling teaching behaviors can be linked to well- and ill-being in students.

Furthermore, the present study revealed a modest negative relationship between the autonomy-supportive and controlling interpersonal styles of teachers, consistent with the findings of previous studies (Assor, Kaplan, & Roth, 2002; Bartholomew et al., 2011; De Mayer et al., 2014). However, a recent study in PE context among Belgian secondary-school students reported a weak negative correlation (−.11) between perceived autonomy support and controlling behavior (Haerens et al., 2015). They suggested that this might be because the immediate assessment of the interpersonal styles of teachers was conducted after classes with reference to only one specific lesson. Unfortunately, the results of the present study, in which a similar data collection procedure was employed, failed to support this explanation. Nevertheless, the results of the present study extend previous findings by providing additional support for the argument that autonomy-supportive and controlling interpersonal styles are best represented as distinct constructs in a PE context. However, more research is needed to further investigate the strength of this relationship.

Finally, invariance analysis revealed that the aforementioned relationships were invariant across male and female students. This result suggested that the mediating effects of need satisfaction and need frustration in the relationships between the interpersonal styles of teachers and the psychological well- and ill-being of students are evident among both boys and girls, and that sex does not influence these relationships. The results are consistent with previous study (Assor et al., 2005).

Although the present study has provided novel evidence regarding the relationships among the interpersonal styles of teachers and the basic psychological needs and psychological experiences of students, several limitations should be recognized that may inspire future research. First, this study only investigated one aspect of need-supportive behavior: autonomy support. Researchers should consider including other need-supportive interpersonal styles, such as structure and involvement, in their future studies. Similarly, only controlling behaviors were examined in this study. Whilst the other aspects of a need-thwarting interpersonal style are yet to be fully extrapolated, future research could also examine chaotic and cold interpersonal behaviors (Haerens, Vansteenkiste, Aelterman, & Van den Berghen, 2016). Second, the interpersonal styles of teachers were measured using self-reporting instruments distributed among students. Previous research in the PE context in Belgium (Haerens, Aelterman, Van den Berghe, De Meyer, Soenens, & Vansteenkiste, 2013) has revealed that not all of the relationships between the observed and perceived need-supportive behaviors of teachers were significant (i.e., structure). This result indicates that student perceptions of teaching behaviors might not accurately reflect reality. Therefore, future studies are encouraged to employ more objective methods to measure the interpersonal styles of teachers, such as an observational approach (Haerens et al., 2013). Third, a convenience sample from government or government-aided secondary schools was used in this study, which may limit the generalizability of the findings. Future studies should consider recruiting more participants from various types of schools in different regions to minimize the influence of the sampling method on the results. Finally, the findings of this study should be interpreted with caution because as it employed a cross-sectional design that prevents causal conclusions from being drawn; therefore, other methods such as longitudinal or cross-lagged designs should be used in future investigations on this topic.

Taken collectively, the findings of the current study suggested that the interpersonal styles of PE teachers were strongly associated with the psychological experiences of their students through need satisfaction and need frustration. The modest negative relationship between the perceived autonomy-supportive and controlling interpersonal styles of teachers suggested that the two interpersonal styles might have been simultaneously employed by the PE teachers (Amoura et al., 2015; Haerens et al., in press; Matosic & Cox, 2014). For example, the teachers may use some controlling behaviors for classroom management and meanwhile acknowledge the difficulties the students may encounter in the PE class to increase students' engagement level. Further, the students of teachers who used autonomy support as their dominant teaching style may have experienced greater need satisfaction, less need frustration, and subsequently greater subjective vitality and less negative affect. In contrast, the students of teachers who used controlling behavior as their dominant teaching style may have experienced greater need frustration and subsequently less subjective vitality and greater negative affect. Although the present study shows relatively low mean scores for control compared to those for autonomy support, it reveals significant associations between controlling and need frustration and negative affect. PE teachers should, therefore, employ more autonomy-supportive behaviors and less controlling behaviors in their practice if possible. This is because autonomy-supportive teaching styles not only significantly contribute to student need satisfaction, which is beneficial to their subjective vitality, but also plays a role in relieving feelings of need frustration among students. However, although a controlling teaching style might not directly influence student experiences of need satisfaction, it could play a significant role in resulting experiences of need frustration, leading to negative affect and decreasing subjective vitality. Therefore, as well as training teachers to be more autonomy supportive, they must be equipped with the skills to identify

and avoid the use of controlling and need thwarting interpersonal strategies (e.g., Cheon & Reeve, 2015).

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Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest exists in working on this study.

Ethical Approval

All procedures performed involving human participants were in accordance with the ethical standards of the institutional and/or national research committee.

Informed Consent Informed consent was obtained from all students who participated in the study and their parents.

Footnotes

[1]"Need thwarting" was first proposed by Bartholomew et al. (2011) as a synonym for the term "need frustration" that has more recently been proposed by Vansteenkiste and Ryan (2013). However, Vansteenkiste and Ryan (2013) and their colleagues Haerens et al. (2015) stated that the term "need thwarting" specifically refers to contextual features that forestall or undermine individual psychological needs, in contrast with "need-supportive" social contexts that promote the satisfaction of psychological needs. Although the term "need thwarting" is used in the Psychological Needs Thwarting Scale in Physical Education, it measures students' experiences of need frustration in a physical education context. In the present study, in line with the suggestions of Vansteenkiste et al., "need thwarting" is used to refer to features of

social contexts and "need frustration" is used to refer to individual experiences regarding psychological needs.

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Fig.1 The proposed relationships among variables

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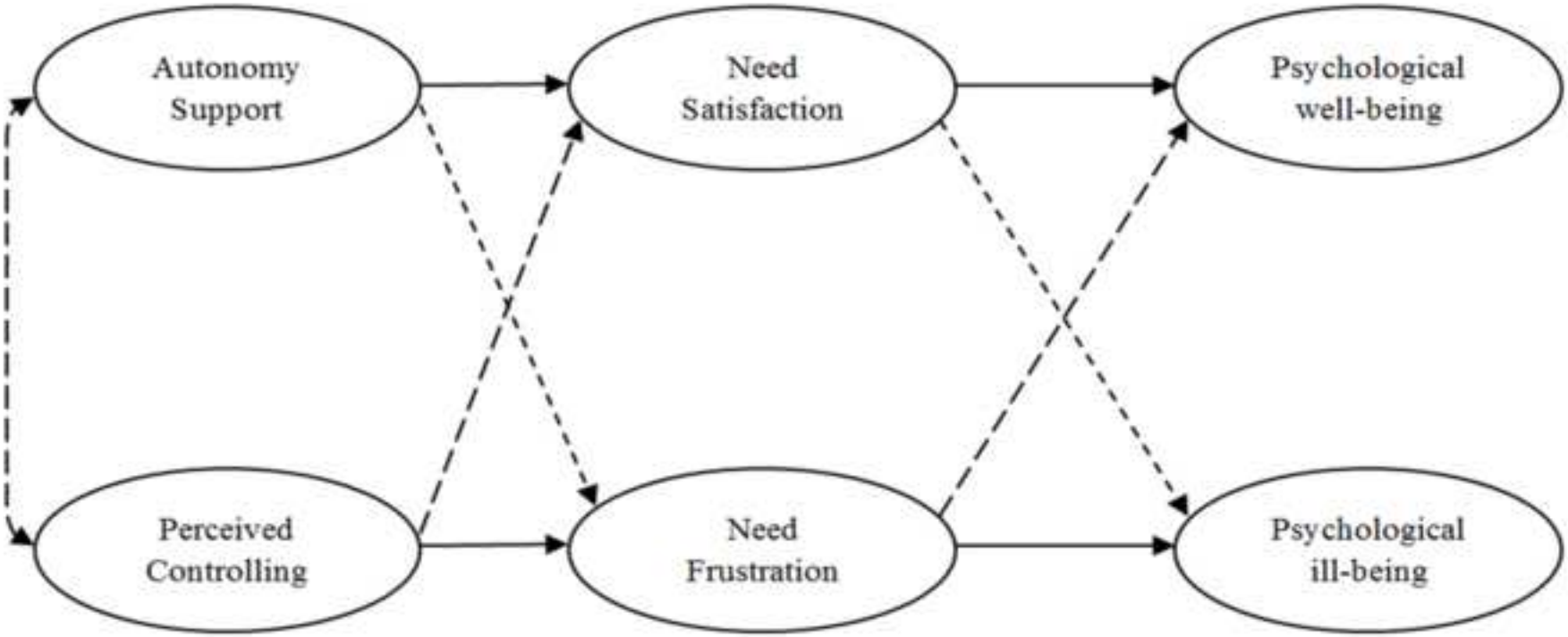

Fig.2 The standardized relationships among variables

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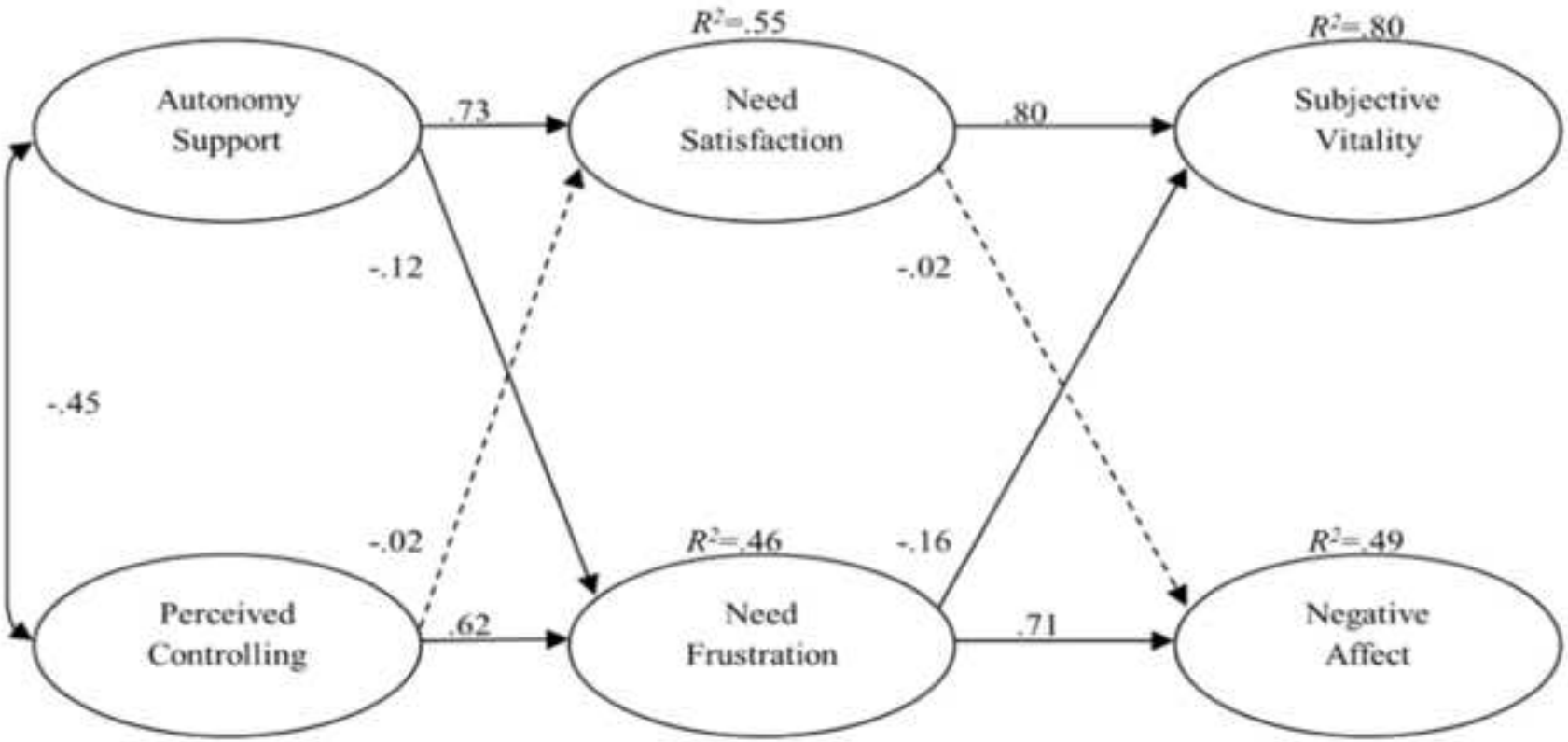

Table 1

Descriptive statistics and correlations among the variables

Variable	Mean	SD	1	2	3	4	5
Autonomy support	4.11	1.13					
Control	2.92	1.13	-.32**				
Need satisfaction	4.45	1.14	.59**	-.24**			
Need frustration	3.07	1.16	-.34**	.53**	-.54**		
Subjective vitality	4.47	1.33	.51**	-.25**	.77**	-.54**	
Negative affect	2.00	.92	-.18**	.30**	-.36**	-.58**	-.39**

**$p < .01$

Table 2

Measurement model statistics

Indicators	Mean	SD	FL	SE	SMC
Autonomy Support (AS)					
ASP1	4.41	1.31	.777	.023	.604
ASP2	4.11	1.29	.879	.019	.774
ASP3	3.81	1.30	.718	.032	.516
Control (PC)					
PCP1	3.37	1.35	.657	.037	.432
PCP2	2.61	1.29	.785	.033	.617
PCP3	2.79	1.58	.609	.047	.371
Subjective Vitality (SV)					
SVP1	4.65	1.45	.811	.021	.657
SVP2	4.36	1.43	.846	.018	.715
SVP3	4.41	1.54	.876	.017	.767
Negative Affect (NA)					
NAP1	1.88	.99	.793	.027	.565
NAP2	2.23	1.04	.874	.021	.764
NAP3	1.89	1.13	.752	.029	.628
Need Satisfaction					
Autonomy	4.32	1.29	.878	.018	.772
Competence	3.91	1.47	.763	.022	.582
Relatedness	5.11	1.26	.688	.028	.473
Need Frustration					
Autonomy	3.29	1.51	.723	.054	.523
Competence	3.38	1.41	.734	.043	.539
Relatedness	2.51	1.29	.706	.042	.499

P parcelling, SD standard deviation, FL factor loading, SE standard error, SMC squared multiple correlation

Table 3

Fit indices for the sex invariance testing of structural model

Model	χ^2	*df*	*p*	CFI	RMSEA (90%CI)	SRMR	Model Comparison	$\Delta\chi^2(\Delta df)$	ΔCFI
Male	380.29	134	.000	.926	.078 (.069-.087)	.063	-		
Female	307.57	134	.000	.936	.068 (.058-.077)	.055	-		
M1	687.86	268	.000	.930	.052(.047-.056)	.055	-		
M2	710.48	280	.000	.928	.051(.046-.056)	.056	M2 vs. M1	22.62(12)	.002
M3	717.65	288	.000	.928	.050(.046-.055)	.057	M3 vs. M2	7.17(8)	.000

M1 unconstrained model, M2 measurement weights are constrained to be equal, M3=measurement weights and structural weights are constrained to be equal, RMSEA root mean square error of approximation, CFI comparative fit index, SRMR standardized root mean square residual