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Students' need satisfaction and frustration profiles: differences in outcomes in physical education and physical activity-related variables

Abstract

Grounded in self–determination theory, the objectives of the present research were to identify latent profiles based on need-based experiences in physical education (PE), and to examine differences in outcomes in PE (i.e. motivation, experiences, and oppositional defiance) and physical activity-related variables outside of PE (i.e. physical activity intention, moderate–to–vigorous physical activity, and meeting physical activity recommendations) across the identified profiles. A purposive sample of 1062 secondary PE students (526 boys and 536 girls; M_{age}=14.15, *SD*=1.51) participated in this cross-sectional study. Results from latent profile analysis revealed four need satisfaction and frustration profiles: "high need satisfaction–low need frustration"; "moderate need satisfaction–low need frustration"; "moderate need satisfaction–moderate need frustration"; and "low need satisfaction–high need frustration". For outcomes in PE, the "high need satisfaction–low need frustration" profile was the most adaptive, while the "low need satisfaction–high need frustration" profile obtained the most maladaptive pattern of outcomes. The "moderate need satisfaction–low need frustration" profile was more adaptive than "moderate need satisfaction–moderate need frustration" profile, although both were similar in experiences and oppositional defiance. For physical activity-related outcomes outside of PE, the "high need satisfaction–low need frustration" profile scored highest, while no differences were obtained among the three remaining profiles. These results provide further insight into the importance for PE teachers not only to support students' need satisfaction, but also to minimize need frustration, in obtaining the most optimal pattern of outcomes in PE, as well as a more active lifestyle among students.

Keywords: Autonomy, competence, relatedness, physical activity, behavioral regulation.

Introduction

It is widely known that physical activity (PA) is related to physical, psychological, and social benefits in youth (García-Hermoso et al., 2021). However, the most recent global prevalence report showed that 77.60% of male and 84.70% of female youth fail to engage in at least 60 minutes of daily moderate–to–vigorous physical activity (MVPA) (Guthold et al., 2020). In light of this situation of global physical inactivity, physical education (PE) represents a potentially suitable context to effectively promote MVPA inside (Hollis et al., 2017) and outside the lessons, by providing students with the knowledge, abilities, and values necessary for lifelong participation (SHAPE America—Society of Health and Physical Educators, 2014). According to self-determination theory (SDT; Ryan and Deci, 2020), one of the most determining factors in fostering positive consequences for PE and PA behavior change in young people is the perception of basic psychological needs (BPNs) in PE lessons (Vasconcellos et al., 2020).

SDT (Ryan and Deci, 2020) conceptualizes autonomy, competence, and relatedness as BPNs for optimal growth and wellness. This theory of human behavior draws a clear distinction between need satisfaction and need frustration, arguing that each person (e.g. student) can experience both perceptions within the same context (e.g. PE) with each differently yielding specific outcomes (Vansteenkiste et al., 2020). However, in PE, most previous studies adopted variable–centered approaches (e.g. structural equation modeling, regression analysis) to analyze the relationship between need satisfaction and/or need frustration and different outcomes in and outside of PE (Haerens et al., 2015; Vasconcellos et al., 2020). To the best of our knowledge, there is one single study that took a person–centered analysis (e.g. latent profile analysis) in PE to examine the association of different students' need satisfaction and frustration profiles with motivation for PE (Warburton et al., 2020), but not with other outcomes in and outside of

PE. Therefore, the question of which configuration of need satisfaction and need frustration yields the most and the least desirable outcomes has received little attention in PE. The present research adopts a person-centered approach to expand previous knowledge of the differences between students' autonomy, competence, and relatedness need satisfaction and frustration profiles in PE and outcomes in (i.e. quality of motivation, experiences, and oppositional defiance) and outside of (i.e. PA intention, MVPA levels, and meeting PA recommendations) PE.

BPNs theory in physical education

SDT conceptualizes the BPNs for autonomy, competence, and relatedness as the essential nutriments for adjustment, growth, and wellness (Ryan and Deci, 2020). This theoretical framework postulates a dual-process model in explaining human functioning by drawing a bright and dark pathway based on the distinction between the satisfaction and the frustration of the three BPNs (Vansteenkiste et al., 2020). While need satisfaction represents the core of the bright pathway of functioning, as it would contribute to proactivity, integration, and wellness, need frustration constitutes the dark pathway of functioning, since it would be prone to passivity, fragmentation, and illness (Ryan et al., 2021; Vansteenkiste et al., 2020). Autonomy satisfaction concerns the experience of initiative and choice of behaviors, whereas autonomy frustration involves being forced to behave in a prescribed manner. Competence satisfaction concerns mastery and capacity to meet expected challenges, whereas competence frustration involves inefficacy and failure to achieve desired goals. Finally, relatedness satisfaction concerns belonging and genuine connections with valued others, whereas relatedness frustration involves loneliness and exclusion from significant others.

SDT-based research has broadly shown in different contexts that need satisfaction and need frustration may co-occur to different degrees, rather than being two opposite

poles along a need-fulfilment continuum. Both are characterized by distinct psychological experiences and are related to different antecedents and consequences (Ryan et al., 2021; Vansteenkiste et al., 2020). In particular, research has well documented that low levels of need satisfaction were consistently associated with feelings of low wellness, but not necessarily with experiences of illness, whereas need frustration was robustly related to illness and malfunctioning (Ryan et al., 2021; Vansteenkiste et al., 2020). For example, a student who feels low need satisfaction in PE lessons might perceive fewer opportunities than he/she desired to choose, not be as good as expected at task completion or display indifferent links with his/her classmates. Instead, another student who experiences need frustration in PE lessons may feel compelled to act as the teacher directs, incompetent, and excluded by his/her peers. Hence, the relationship between low need satisfaction and the presence of need frustration is believed to be asymmetrical (Ryan et al., 2021; Vansteenkiste et al., 2020). In other words, low levels of need satisfaction do not necessarily imply the presence of need frustration, as they do not adequately capture the active nature that defines any experience of need frustration, whereas need frustration entails low need satisfaction (Ryan et al., 2021; Vansteenkiste et al., 2020). Consequently, SDT proposes that need satisfaction and need frustration can simultaneously interact within the same context, with each being related differently to specific antecedents and outcomes (Ryan et al., 2021).

In the PE context, a substantial body of research has gathered support for the bright pathway with positive relationships between students' need satisfaction in PE and an array of adaptive consequences, including autonomous motivation (i.e. behavior is undertaken for inherent enjoyment, inclusion in the student's lifestyle or the benefits derived), and positive PE experiences (Behzadnia, 2021; García-González et al., 2019; Haerens et al., 2015, 2019; Leo et al., 2022; Tilga et al., 2020; Vasconcellos et al., 2020).

Furthermore, previous research has evidenced a dark pathway with positive relationships between students' need frustration and a range of maladaptive outcomes, including controlled motivation (i.e. behavior is undertaken by coercion and self-imposed or external pressures), amotivation (i.e. the total absence of volition toward the behavior), and oppositional defiance in PE (i.e. a forceful resistance against the teacher's authority) (Abós et al., 2022; Behzadnia, 2021; García-González et al., 2019; Haerens et al., 2015, 2019; Leo et al., 2022; Tilga et al., 2020; Vasconcellos et al., 2020).

Previous studies in PE have also suggested a "buffering role" (cross-path) of need satisfaction against maladaptive outcomes. In this line, negative but weaker associations of need satisfaction with controlled motivation, amotivation, and oppositional defiance have been found (García-González et al., 2019; Haerens et al., 2015, 2019; Leo et al., 2022). Similarly, need frustration has been found to play a "hampering role" (cross-path) on adaptive outcomes. Thus, negative and weaker relationships between need frustration and autonomous motivation in PE have been found (García-González et al., 2019; Haerens et al., 2015, 2019; Leo et al., 2022).

On the other hand, little is known about the trans–contextual effects of students' need satisfaction and frustration in PE on PA-related variables outside this context. Specifically, the trans-contextual model of motivation holds the premise that autonomy, competence, and relatedness satisfaction in the PE context may transfer to need satisfaction in a similar context (i.e. PA context) (Barkoukis et al., 2010; González-Cutre et al., 2014). Previous research has found a positive relationship between students' need satisfaction in PE and PA intention (i.e. the degree of willingness to continue PA behavior for at least a few months) (Di Battista et al., 2019) and MVPA levels (Gråstén et al., 2021). A negative relationship between students' need frustration in PE and PA-related outcomes has also been found in the few existing studies (Koka et al., 2019, 2020).

Need satisfaction and frustration profiles

Much of the previous research on PE adopted variable–centered approaches to examine the relationship of students' need satisfaction and/or frustration to different outcomes in and outside of PE (Vasconcellos et al., 2020). These variable-centered analyses (e.g. structural equation modeling, regression analysis) do not allow us to know whether people can perceive several variables simultaneously and what differences exist between these various combinations (i.e. profiles) in the variables under study. To overcome this limitation, person–centered approaches allow researchers to identify homogenous subgroups of students based on target variables (Weller et al., 2020). Thus, person–centered analyses (e.g. latent profiles analysis) make it possible to examine the different combinations of both need-based experiences on different outcomes in and outside of PE.

To date, a few person–centered studies, based on need satisfaction and frustration, have been found in distinct domains (e.g. general, work, education, or sport) with different samples (e.g. youngsters, adults, or elderly) and regarding several wellness/illness outcomes (Li et al., 2022; Rouse et al., 2020; Tóth-Király et al., 2020). All these studies found between three and five need satisfaction and need frustration profiles with two common profiles characterized by high need satisfaction–low need frustration, and low need satisfaction–high need frustration, as well as a series of profiles supporting the asymmetrical relationship between need satisfaction and frustration (e.g. moderate need satisfaction–moderate need frustration). While the profile called "high need satisfaction–low need frustration" was associated in all studies with adaptive consequences, the profile called "low need satisfaction–high need frustration" was associated with maladaptive consequences (e.g. Li et al., 2022; Tóth-Király et al., 2020; Warburton et al., 2020). Further, profiles with moderate need satisfaction, paired with

moderate or low need frustration, tended to be less detrimental in maladaptive outcomes (Li et al., 2022; Rouse et al., 2020; Tóth-Király et al., 2020).

To the best of our knowledge, there is only one person–centered research based on students' need satisfaction and frustration in PE (Warburton et al., 2020). This study identified three need profiles in terms of composite scores for need satisfaction and frustration: 1) "high need satisfaction–low need frustration", 2) "moderate need satisfaction and need frustration", and 3) "low need satisfaction–high need frustration", which differed from each other in motivational outcomes within the PE context. While the "high need satisfaction–low need frustration" group of students was the highest in autonomous forms of motivation and the lowest in controlled forms of motivation and amotivation, the "low need satisfaction–high need frustration" profile was the most maladaptive in quality of motivation. Although this research made a valuable contribution to the field of PE, it analyzed need satisfaction and need frustration together, which may mask the role that each of them plays separately in the PE lesson. It is suggested that the three BPNs should be equally satisfied to have an additional source of quality of motivation and functioning in PE lessons (Mouratidis et al., 2015). Therefore, it is necessary to gain more in-depth knowledge of how the satisfaction and frustration of the needs for autonomy, competence and relatedness are independently combined in PE lessons. In addition, there is a need to expand evidence on the potential effects of these combinations of satisfaction and frustration of the three BPNs not only on motivation for PE (Warburton et al., 2020), but also on other learning-related outcomes in and outside of the PE lesson. This substantial body of evidence could be useful for PE teachers to know which profiles of need satisfaction and frustration may be the most and least adaptive in order to provide a need-supportive learning environment in PE lessons.

The present research

A first objective of the current study was to analyze within–person combinations (i.e. profiles) of students' perceptions of autonomy, competences, and relatedness need satisfaction and need frustration in PE. Consistent with previous person–centered research in PE (Warburton et al., 2020) and other domains (Li et al., 2022; Rouse et al., 2020; Tóth-Király et al., 2020), we expected to find two profiles with the following characteristics: 1) "high need satisfaction–low need frustration", and 2) "low need satisfaction–high need frustration". Because need satisfaction and need frustration are conceptualized as two distinguishable but related variables (Li et al., 2022; Vansteenkiste et al., 2020; Warburton et al., 2020), we also expected to identify other need profiles characterized by being moderate in either need satisfaction or frustration or both.

A second objective was to examine differences in these resulting need satisfaction and frustration profiles in terms of outcomes in (i.e. quality of motivation, experiences, and oppositional defiance) and outside of PE (i.e. PA intention, MVPA, and meeting PA recommendations). Guided by SDT assumptions (Vansteenkiste et al., 2020) and previous research in PE (Warburton et al., 2020) and other domains (Li et al., 2022; Rouse et al., 2020; Tóth-Király et al., 2020), we hypothesized that the "high need satisfaction–low need frustration" profile would be associated with more adaptive outcomes, while the "low need satisfaction–high need frustration" profile would be related to the more maladaptive outcomes in and outside of PE. Additionally, consistent with previous studies (Haerens et al., 2015; Vasconcellos et al., 2020), we aimed to explore whether the other identified profiles supported the possible protective effect of need satisfaction on negative effects of need frustration to a certain degree under the study variables.

Method

Design and participants

An initial sample of 1118 Spanish secondary students, from five of eight public secondary school in a Spanish medium-sized city, took part in this cross-sectional study. A purposive sampling technique for recruitment and selection of participants was used. After verifying those students who submitted signed informed parental/guardian consent, the sample included 1087 (response rate: 97.23%) students. Data screening also suggested the need to eliminate 10 univariate (Z–scores over 3) and 15 multivariate (Mahalanobis distances with $p<.001$) outliers before further analysis.

The final sample of this research consisted of 1062 secondary students (526 male and 536 female), aged between 11 and 18 years (M_{age}=14.15, SD=1.51) (for more details, see data analysis section). Most of students self-reported being white (n=943, 88.79%), while the remaining 11.21% (n=119) belonged to different ethnic minorities. They were in the first (n=174, 16.38%), second (n=333, 31.36%), third (n=146, 13.75%), and fourth (n=162, 15.25%) grade of compulsory secondary education, and the first (n=247, 23.26%) grade of post-compulsory secondary education. In Spain, students receive two 60-minute compulsory and coeducational PE lessons per week. Classroom sizes range from 20 to 30 students per classroom.

Instruments

Profile variables

Need satisfaction and need frustration in PE. To assess students' perceptions of need-based experiences in PE, the Spanish PE version (Zamarripa et al., 2020) of the Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2015) was used. The instrument is headed by the stem "In my PE lessons…" and followed by 24 items (four per factor) measuring autonomy satisfaction (e.g. "I feel I have been doing what really interests me"), competence satisfaction (e.g. "I feel I can successfully complete difficult tasks"), relatedness satisfaction (e.g. "I experience a warm feeling with my

classmates I spend time with"), autonomy frustration (e.g. "I feel pressured to do too many tasks"), competence frustration (e.g. "I feel like a failure because of the mistakes I make"), and relatedness frustration (e.g. "I feel excluded from the group I want to belong to"). Items are scored on a 5-point Likert-type scale from 1 (strongly disagree) to 5 (strongly agree). In this study, the six-factor correlated model obtained an acceptable fit to the data: $\chi^2(df=237)=997.78$, $p<.001$, $\chi^2/df=4.21$; CFI=.94; TLI=.93; SRMR=.049; RMSEA=.071(90%CI=.067–.074).

Outcomes in PE

Motivation for PE. To assess students' perceptions of their behavioral regulation for PE, the Spanish version (Ferriz et al., 2015) of the Perceived Locus of Causality Scale (Goudas et al., 1994) was used. The instrument is headed by the stem "I participate in PE classes…" and is followed by 24 items (four per factor) measuring intrinsic motivation (e.g. "because I enjoy learning new skills"), integrated regulation, (e.g. "because I consider PE is consistent with my values"), identified regulation (e.g. "because I want to improve in PE"), introjected regulation (e.g. "because I want to get a good report in PE"), external regulation (e.g. "because I'll get in trouble if I don't"), and amotivation (e.g. "I don't see why we should have PE lessons"). Items are scored on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). In line with the SDT's assumptions (Ryan et al., 2021) and previous research (Burgueño et al., 2019), this study supported a hierarchical three-factor model consisting of autonomous motivation (including primary-order factors of intrinsic motivation, integrated, and identified regulation), controlled motivation (including primary-order factors of introjected and external regulation), and amotivation ($\chi^2[df=244]=818.251$, $p<.001$, $\chi^2/df=3.35$; CFI=.96; TLI=.95; SRMR=.036; RMSEA =.047 [90%CI=.044–.051]).

PE experiences. To assess students' perceived affective experiences in terms of sensations, feelings and emotions in PE lessons, the question: "How are your experiences in the PE subject?" was used, following previous research (Diloy-Peña et al., 2021). This question is scored on a one-item 5-point Likert-type scale, including 1 (very bad), 2 (bad), 3 (regular), 4 (good), and 5 (very good).

Oppositional defiance. To assess students' perceptions of oppositional defiance toward their PE teacher, the Spanish version (Abós et al., 2016) of the oppositional defiance in PE questionnaire (Haerens et al., 2015) was used. The unidimensional instrument is headed by the stem "During my PE lessons…" and includes four items (e.g. "I have the tendency to rebel against the teacher's requests"). Each of them is scored on a 5-point Likert-type scale from 1 (strongly disagree) to 5 (strongly agree). In this research, the one-factor model obtained a good fit: $\chi^2(df=2)=3.18$, $p=.204$, $\chi^2/df=1.59$; CFI=1.00; TLI=1.00; SRMR=.009; RMSEA=.024 (90%CI=.000–.070).

Outcomes outside of PE

PA intention. To assess students' perceptions of PA intention, the Spanish version (González-Cutre et al., 2014) of the PA intention subscale from the Theory of Planned Behavior Questionnaire (Hagger et al., 2009) was used. The subscale was headed by the stem "During the next five weeks…" and included three items (e.g. "I plan to do active sports and/or vigorous physical activities during my leisure time"). Each of them is scored on a 7-point Likert-type scale from 1 (strongly disagree) to 7 (strongly agree). In this research, one-factor model obtained a good fit: $\chi^2(df=1)=5.84$, $p<.090$, $\chi^2/df=5.84$; CFI=.99; TLI=.96; SRMR=.022; RMSEA=.056(90%CI=.046–.068).

MVPA levels. To assess students' daily MVPA levels, the Spanish version (Aibar et al., 2016) of the International Physical Activity Questionnaire–Short Form (IPAQ-SF; Craig et al., 2003) was used. This Spanish version includes a modified version of the

IPAQ-SF protocol given the problems and difficulties detected by students in previous studies. These modifications include: 1) groups of five students for each researcher to resolve possible doubts, 2) explanation of the intensity of different types of activities with images, and 3) daily recording of MVPA levels in the previous week to facilitate their recall. This questionnaire has been shown to be valid and reliable (Aibar et al., 2016) to assess MVPA levels (Craig et al., 2003). The IPAQ-SF modified version obtained much better levels of agreement for MVPA levels between the questionnaire and accelerometers than the previous version (Aibar et al., 2016). Daily MVPA time was calculated by adding the daily time from Monday to Sunday and dividing it by seven days.

PA recommendations. Meeting World Health Organization PA guidelines (i.e. at least 60 minutes of MVPA/day) for adolescents were calculated (Bull et al., 2020) using the previous calculated minutes/day of MVPA. Students were categorized as "yes" when they met these PA guidelines, and "no" when did not meet these recommendations.

Procedure

The researchers obtained approval from the Ethics Committee of University of Extremadura (code: 153/2022), all permissions and authorizations from the management team of each participating secondary school and written informed consent from parents or guardians of each student. Participants took part in the research voluntarily and anonymously and did not receive any compensation for their participation. They individually completed a paper-and-pencil questionnaire in their classrooms without the presence of their PE teacher so as not to influence their responses. The researchers explained to the students that there were no correct or incorrect answers, as the study focused on their perceptions and opinions about PE classes and PA-related behaviors. In addition, the researchers were available to resolve any doubts that might have arisen

during the completion of the questionnaires. The total duration of the data collection process was approximately 30 minutes.

Data analysis

While descriptive statistics (mean scores and standard deviations), McDonald's omega reliability coefficient, and Pearson's correlations were computed for continuous variables; descriptive statistics (percentage) and Spearman's correlations were estimated for categorical variables. SPSS version 28 was used to conduct these analyses. Latent profile analysis, based on autonomy, competence, and relatedness satisfaction and frustration, and mean differences between profiles were run using Mplus version 8.4. In particular, for identification of potential autonomy, competence, and relatedness need satisfaction and need frustration profiles in PE, a latent profile analysis was run using factor scores (with a mean of zero and a standard deviation of one). These factors were generated from preliminary factor analysis to verify the psychometric properties of the measures. All models, ranging from one to five profiles, were calculated by the robust maximum likelihood estimator. Every model was computed with 5000 random sets of start values, 1000 iterations and the 200 best solutions were retained to avoid suboptimal local maximum (Muthén and Muthén, 1998-2017). The means and the variance of the factors were freely estimated in all profiles (Muthén and Muthén, 1998-2017). For selection of the best-fit profile solution, a series of model fit criteria were taken into account (Weller et al., 2020). First, the bootstrapped Lo–Mendell–Rubin likelihood test (LMR) was utilized to compare the fit of two models. Profiles were iteratively added to identify the best-fit model. A significant LMR test (p<.050) indicates that the target profile solution fits the data better than a profile solution with one fewer profile (Weller et al., 2020). Second, Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Sample-Size Adjusted Bayesian Information Criteria (SSA-BIC)

were analyzed, displaying a better model fit with lower scores (Weller et al., 2020). Third, entropy was also examined, indicating that values as low as .80 reflect an acceptable degree of accuracy of profile membership assignment (Weller et al., 2020). Fourth, it was additionally considered that the number of adolescents in each profile had to be greater than 5% of the total sample (Weller et al., 2020).

Finally, to test if need satisfaction and need frustration profiles differed to each other in motivation for PE, PE experiences, oppositional defiance in PE, PA intention, and MVPA, the auxiliary "BCH" function, which is appropriate for continuous outcomes of Mplus (Muthén and Muthén, 1998-2017), was used. For categorial outcomes, the auxiliary "DCATEGORICAL" function of Mplus (Muthén and Muthén, 1998-2017) was applied to analyze differences in meeting PA recommendations between resulting need satisfaction and frustration profiles. As the students' motivational processes could be affected by gender, age and school (Vasconcellos et al., 2020), distribution by gender, age and school was analyzed to control for them across the tested latent profile models. The level of statistical significance was set at $p<.05$.

Results

Descriptive statistics, reliability coefficients, and correlations among variables

Table 1 shows mean scores above the midpoint of the measurement scale for autonomy, competence, and relatedness satisfaction, as well as autonomous motivation, PE experiences, and PA intention. In addition, there were mean scores below the midpoint of the measurement scale for autonomy, competence, and relatedness frustration, controlled motivation, amotivation, and oppositional defiance in PE. Furthermore, students reported 47.98 minutes/day of MVPA, and only 31.92% of them met PA recommendations. McDonald's omega coefficient obtained values from .71 to .90, indicating a good level of reliability for the totality of variables (Viladrich et al., 2017).

On the other hand, the satisfaction of the three needs was positively correlated with autonomous motivation in PE, PE experiences, PA intention, MVPA levels, and meeting PA recommendations. Similarly, the frustration of each need was positively correlated with controlled motivation, amotivation, and oppositional defiance in PE.

[INSERT TABLE 1 NEAR HERE, PLEASE]

Identification and interpretation of the latent autonomy, competence, and relatedness need satisfaction and need frustration profiles in PE

Fit indices, entropy, and model comparisons are reported in Table 2. Overall, AIC, BIC, and SSA-BIC values were progressively lower, indicating a steady improvement of the model, as additional profiles were added, with the lowest fit being in the 6-profile solution. However, it should be noted that the 5-profile and 6-profile models had a profile with less than 5% of the sample, and non-significant differences in LMR tests compared to the 4-profile solution were found. In comparison with the 4-profile model, the 2-profile and 3-profile models obtained higher parsimony values and significant differences in the LMR test. Considering all the above, the 4-profile model was interpreted to represent the most suitable, theoretically meaningful, and parsimonious solution.

[INSERT TABLE 2 NEAR HERE, PLEASE]

The 4-profile model is depicted in Figure 1 and described in Table 3. Taking into consideration the raw scores, profile 1 (n=625, 58.85%) was labeled as “high need satisfaction–low need frustration” by being characterized by raw scores of 3.67, 4.03, and 4.33 out of 5 in autonomy, competence, and relatedness satisfaction, and of 1.87, 1.47, and 1.12 out of 5 in autonomy, competence, and relatedness frustration. Profile 2 (n=176, 16.57%) was named “moderate need satisfaction–low need frustration” as it was characterized by raw scores of 3.11, 3.44, and 3.77 out of 5 in autonomy, competence, and relatedness satisfaction, and of 2.04, 2.17, and 2.09 out of 5 in autonomy,

competence, and relatedness frustration. Profile 3 (n=65, 6.12%) was labeled as "moderate need satisfaction and frustration" by being characterized by raw scores of 3.10, 3.30 and 3.71 out of 5 in autonomy, competence, and relatedness satisfaction, and of 3.03, 2.64, and 2.73 out of 5 in autonomy, competence, and relatedness frustration. Profile 4 (n=196, 18.46%) was labeled "low need satisfaction–high need frustration" as it was characterized by raw scores of 2.27, 2.74, and 1.16 out of 5 in autonomy, competence, and relatedness satisfaction, and of 3.48, 3.09 and 3.34 out of 5 for autonomy, competence, and relatedness frustration.

[INSERT FIGURE 1 NEAR HERE, PLEASE]

Differences in students' outcomes in and outside of PE between need satisfaction and frustration profiles

Latent profile differences in students' outcomes in PE and PA-related variables outside of PE are displayed in Table 3. Prior to the analysis, a first overall mean equality test found non-significant differences in gender (χ^2=0.56, p=.454), age (χ^2=0.64, p=.424) and school (χ^2=1.65, p=.199), suggesting that students were homogeneously distributed across the four profiles according to these covariates.

For outcomes in PE, a second overall mean equality test was significant for autonomous motivation (χ^2=245.28, p<.001), controlled motivation (χ^2=98.19, p<.001), amotivation (χ^2=213.58, p<.001), experiences in PE (χ^2=56.78, p<.001), and oppositional defiance in PE (χ^2=90.101, p<.001) between the four retained profiles. More specifically, pairwise comparisons revealed that students from Profile 1 (i.e. high need satisfaction–low need frustration) scored highest on autonomous motivation and PE experiences, as well as lowest on controlled motivation, amotivation, and oppositional defiance in PE. Conversely, students from Profile 4 (i.e. low need satisfaction–high need frustration) scored lowest on autonomous motivation and PE experiences and highest on amotivation.

Students from Profile 3 (i.e. moderate need satisfaction and frustration) showed the highest score in controlled motivation. Students from Profile 2 (i.e. moderate need satisfaction–low need frustration) scored significantly higher than students from Profile 3 in autonomous motivation and lower on amotivation. Likewise, students from Profile 2 did not significantly differ from students from Profile 3 in PE experiences and oppositional defiance, the same way as students from Profile 3 were not significantly different from students from Profile 4 in oppositional defiance.

For outcomes outside of PE, a third overall mean equality test was significant for PA intention (χ^2=132.79, p<.001), MVPA (χ^2=88.21, p<.001), and meeting PA recommendations (χ^2=72.19, p<.001) between the four identified profiles. More specifically, pairwise comparisons showed that while students from Profile 1 obtained the highest scores on PA intention, MVPA levels, and meeting PA recommendations, students from the three remaining profiles were not significantly different in PA intention, MVPA levels, and meeting PA recommendations.

[INSERT TABLE 3 NEAR HERE, PLEASE]

Discussion

The purposes of this research were: 1) to examine the number of autonomy, competence, and relatedness satisfaction and frustration profiles in PE; and 2) to analyze differences in identified need satisfaction and frustration profiles (aim 1) in terms of outcomes in and outside of PE. The main findings of this study are as follows: 1) need satisfaction and need frustration in PE may co-occur to different degrees according to students' perceptions; 2) the "high need satisfaction–low need frustration" profile showed the most optimal patterns of outcomes in and outside of PE; 3) the "low need satisfaction–high need frustration" profile yielded the least optimal pattern of outcomes in PE; 4) the "moderate need satisfaction–low need frustration" profile tended to be more adaptive than

the "moderate need satisfaction–moderate need frustration" profile in outcomes in PE; 5) the "moderate need satisfaction–low need frustration", "moderate need satisfaction–moderate need frustration", and "low need satisfaction–high need frustration" profiles did not differ from each other in outcomes outside of PE.

Concerning the first purpose, four profiles with varying levels of need satisfaction and need frustration were identified, consistent with our hypothesis and previous research (Tóth-Király et al., 2020). This number of profiles, nonetheless, contrasted with the three-profile (Li et al., 2022; Warburton et al., 2020) and the five-profile (Rouse et al., 2020) solutions reported by previous studies. A plausible explanation would rest on the: 1) specific contextual differences between PE and other contexts (e.g. sport or work), 2) the varied sample sizes (n=160 to 2236) across the different studies, and 3) variability in the composition of the profiles (i.e. composite or independent factors) in each study. Specifically, some studies considered composite scores for need satisfaction and need frustration profiles (Li et al., 2022; Rouse et al., 2020; Warburton et al., 2020), while in another study, similar to this one, profiles were based on mean scores for autonomy, competence, and relatedness satisfaction and frustration (Tóth-Király et al., 2020).

The results from the current research showed that two of the four profiles gathered support for the asymmetrical relationship between need satisfaction and need frustration (Vansteenkiste et al., 2020), such that there were two student groups who perceived high need satisfaction–low need frustration and low need satisfaction–high need frustration. This suggests that when students experience high pressure for task development (autonomy frustration), a strong sense of inefficacy toward it (competence frustration), and direct exclusion from their teacher and/or classmates (relatedness frustration) in PE lessons, they are less likely to perceive high need satisfaction. Conversely, when students perceive low need frustration, they would be prone to experience many opportunities and

choices for the ongoing task development (autonomy satisfaction), a strong sense of mastery for the target task (competence satisfaction), and a close link with their teacher and/or classmates in the PE lessons (relatedness satisfaction). These two profiles accounted for slightly more than three-quarters (77.16%) of the students in this research.

The emergence of two profiles with moderate-to-low levels of need satisfaction and need frustration featured approximately one-quarter (22.84%) of the participating sample of the present study. The "moderate need satisfaction–moderate need frustration" profile was often identified in previous studies (Li et al., 2022; Tóth-Király et al., 2020; Warburton et al., 2020), while the "moderate need satisfaction–low need frustration" profile arose as a "peripheral" or less common profile due to the specific contextual features of PE (Howard et al., 2016). Both profiles, which are not simply characterized by opposite perceptions of need satisfaction and frustration, underpinned the premise that students could simultaneously experience both need satisfaction and need frustration during PE lessons. This would mean that for students who experience certain opportunities to choose their learning pace or the material for the task (autonomy satisfaction), some sense of being good at it (competence satisfaction), and close links with their teacher and/or classmates (relatedness satisfaction) during PE lessons, they could also perceive that they have to perform tasks in a prescriptive manner (autonomy frustration), inefficacy when performing wrong (competence frustration), and relative exclusion by their peers and/or teacher from tasks at a given point (relatedness frustration). These findings provide evidence in support of the clearly different nature of need satisfaction and need frustration and the possible co-occurrence among students within the PE lessons.

Regarding the second purpose, the four identified need profiles were significantly different in outcomes in and outside of PE. Consistent with our hypotheses and following

previous person–centered research on PE (Warburton et al., 2020), the "high need satisfaction–low need frustration" profile was the most adaptive, given that students scored highest on autonomous motivation for PE, experiences in PE, PA intention, MVPA levels, and meeting PA recommendation, as well as lowest on controlled motivation, amotivation and oppositional defiance in PE lessons. It is likely that when students perceive choices (autonomy satisfaction), efficacy in ongoing tasks (competence satisfaction), and positive links with their peer group (relatedness satisfaction), in the presence of low perceived need frustration, they could participate in PE out of enjoyment, interest, and because they personally value it (autonomous motivation). In addition, students' satisfaction of the three BPNs could reduce self-imposed and external reasons (controlled motivation), the absence of intrinsic and extrinsic reasons (amotivation), and forceful resistance against the teacher (oppositional defiance) in the PE lessons. Complementary to variable–centered studies on PE (Di Battista et al., 2019; González-Cutre et al., 2014; Gråstén et al., 2021), this person–centered study on PE provided evidence indicating that high need satisfaction paired with low need frustration in PE was associated with higher PA-related variables outside of PE. This could be since students who perceive that their BPNs are satisfied and not frustrated in PE are more likely to be more autonomously motivated not only in this subject, but also toward PA outside of school. According to the trans-contextual model (Hagger et al., 2009), this link implies that need satisfaction in PE may transfer to out-of-school contexts, potentially resulting in a greater intention to participate in a wide variety of physical activities and, consequently, higher MVPA levels and meeting PA recommendations.

In accordance with previous person–centered research on PE (Warburton et al., 2020) and SDT assumptions (Vansteenkiste et al., 2020), the "low need satisfaction–high need frustration" profile was the most maladaptive in terms of motivational quality in PE

and negative PE experiences. According to SDT, a possible rationale could be that when students perceive feeling pressure and coercion to complete the target tasks in a prescribed manner (autonomy frustration), a strong sense of inefficacy during ongoing task development (competence frustration), and direct rejection from their classmates and/or teachers (relatedness frustration), in the presence of low need satisfaction, they are prone to have no autonomous or controlled reasons for PE participation (amotivation), as well as negative PE experiences in practice.

Partially consistent with our hypotheses, our results also indicated that the "moderate need satisfaction–low need frustration" and "moderate need satisfaction–moderate need frustration" profiles could not only compensate for the detrimental effects of need frustration on amotivation and oppositional defiance, but also enhance autonomous motivation and positive experiences in PE lessons. It should be noted, however, that the "moderate need satisfaction–low need frustration" profile was more adaptive than the "moderate need satisfaction–moderate need frustration" profile, suggesting that when need satisfaction was moderate, relatively different levels of need frustration were shown to be the trigger of more or less detrimental effects on students' outcomes inside of PE. Moreover, our findings indicated that moderate levels of need satisfaction in PE could not attenuate negative effects of low–to–high levels of need frustration in PE on students' outcomes outside of PE lessons. Our results suggest that students' need satisfaction in PE does not seem to play a fully protective role against need frustration in PE in the development of an active lifestyle outside of PE. It is likely that when students perceive low-to-moderate levels of need frustration, in the presence of moderate need satisfaction, they could feel less intention to participate in a wide variety of physical activities, engage in less PA levels, and therefore do not meet the PA recommendations.

Limitations and future perspectives

Although this research contributes to the SDT literature in the PE context, several limitations should be recognized. First, the use of a cross-sectional design makes it impossible to infer causal relationships among the study variables. Additional longitudinal studies should test the temporal stability of the need satisfaction and frustration profiles and analyze the directionality between these profiles, as well as outcomes in and outside of PE. These endeavors may also allow researchers to explore within–person and between–person changes in need profiles over the academic year in PE. Second, the use of a purposive sample suggests interpreting the results with caution. It is recommended that in future research a representative sample of adolescents with different social and cultural backgrounds, educational levels (e.g. primary education or professional education), or types of school (e.g. private) participate in the study. Third, this research intentionally analyzed differences in need satisfaction and frustration profiles in motivational outcomes, oppositional defiance, and experiences in PE and PA-related variables outside of PE. Additional research may include potential antecedents of students' need-based experiences in PE lessons, such as need-supportive and need-thwarting behaviors from PE teachers, as well as other affective, cognitive, and behavioral outcomes in and outside of PE. Fourth, even though students were homogeneously distributed across the retained profiles according to gender, age and school, the belonging of every student to a class was not taken into account in this research and might have influenced the differentiated relationships between the retained need profiles and the target outcomes. Additional studies are needed to explore the multilevel character of the classroom in the associations of need satisfaction and need frustration profiles with outcomes in and outside of PE through person-centered approaches. Fifth, although all the questionnaires used are valid and reliable, all the variables in the study are self-

reported, so there could be a bias in the results found. Further, consistent with previous research arguing that single-item instruments are considered appropriate (e.g., Matthews et al., 2022), a single-item instrument was used to measure the students' perception of PE experiences. Future studies should validate a multi-item scale to capture students' experiences in PE lessons. Finally, future studies could use accelerometer–measured PA to obtain a more accurate measurement of physical activity levels in and outside of PE.

Conclusions

The results of the present research identified four different profiles, based on autonomy, competence and relatedness satisfaction and frustration, supporting the premise that need satisfaction and need frustration are best conceptualized as separate and distinguishable, but co-occurring experiences in PE. Further, the results displayed that the "high need satisfaction–low need frustration" profile was the most adaptive in terms of quality of motivation, experiences, and oppositional defiance (outcomes in PE), as well as in PA intention, MVPA levels, and meeting PA recommendations (outcomes outside of PE). Conversely, the "low need satisfaction–high need frustration" profile obtained the most maladaptive in patterns of outcomes in and outside of PE. Overall, the results of this research underline the importance of not only fostering students' need satisfaction in PE lessons, but also minimizing need frustration since need satisfaction could not fully attenuate the detrimental effects from low–to–high levels of need frustration to adaptive outcomes in and, especially, outside of PE.

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Table 1

Descriptive statistics, reliability coefficients, and correlations among study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Autonomy satisfaction in PE	-	.58***	.46***	-.34***	-.24***	-.08*	.41***	-.19***	-.43***	.23***	-.25***	.27***	.06*	.13***
2. Competence satisfaction in PE		-	.52***	-.33***	-.34***	-.10*	.53***	-.22***	-.47***	.24***	-.25***	.34***	.07*	.21***
3. Relatedness satisfaction in PE			-	-.25***	-.27***	-.28***	.43***	-.19***	-.44***	.24***	-.26***	.31***	.01	.18***
4. Autonomy frustration in PE				-	.45***	.31***	-.41***	.27***	.42***	-.20***	.28***	-.31***	-.02	-.22***
5. Competence frustration in PE					-	.44***	-.36***	.30***	.37***	-.19***	.27***	-.31***	-.07*	-.30***
6. Relatedness frustration in PE						-	-.21***	.23***	.26***	-.08**	.17***	-.19***	-.03	-.13***
7. Autonomous motivation for PE							-	-.15***	-.66***	.21***	-.30***	.51***	.07*	.28***
8. Controlled motivation for PE								-	.21***	-.11***	.22***	-.22***	-.04	-.23***
9. Amotivation for PE									-	-.26***	.36***	-.42***	-.07*	-.29***
10. PE experiences										-	-.18***	.23***	.05	.15***
11. Oppositional defiance in PE											-	-.21***	-.02	-.18
12. PA intention												-	.13***	.62***
13. MVPA levels (minutes)													-	.81***
14. PA recommendations														-
Range	1-5	1-5	1-5	1-5	1-5	1-5	1-7	1-7	1-7	1-5	1-5	1-7	0-600	Yes/no
M	3.29	3.65	4.07	2.37	1.90	1.42	5.14	3.41	1.97	4.19	1.88	5.16	47.98	31.92%yes
SD	1.01	0.91	0.70	1.08	0.97	0.65	1.31	1.42	1.37	0.82	0.81	1.60	186.77	-
McDonald's omega	.81	.77	.71	.80	.86	.81	.90	.85	.89	-	.80	.89	-	-

Note. PE: Physical education; PA: Physical activity; MVPA: Moderato-to-vigorous physical activity. ***p<.001, **p<.010, *p<.050

Table 2

Fit indexes, entropy, and model comparisons for models from need satisfaction and frustration latent profile analysis

Model	AIC	BIC	SSA-BIC	LMRT(p)	Entropy	Number of profiles	Np<5%
1 profile	16413.04	16472.65	16434.54	-	-	1062	0
2 profiles	15384.23	15478.62	15418.27	<.001	0.796	749; 313	0
3 profiles	14848.22	14977.38	14894.80	<.001	0.832	277; 683; 102	0
4 profiles	14496.84	14660.79	14555.97	.004	0.895	196; 625; 176; 65	0
5 profiles	14282.98	14481.70	14354.65	.051	0.890	182; 147; 632; 73; 28	1
6 profiles	14098.94	14332.43	14183.15	.100	0.831	95; 383; 28; 149; 335; 72	1

Note. LMRT: Lo–Mendell–Rubin likelihood test; Np<5%: Number of profiles with less than 5% of participants.

Table 3

Mean differences in students' outcomes in and outside of PE between need satisfaction and frustration latent profiles

	Profile 1 (n=625) High satisfaction–Low frustration	Profile 2 (n=176) Moderate satisfaction–Low frustration	Profile 3 (n=65) Moderate satisfaction - Moderate frustration	Profile 4 (n=196) Low satisfaction–High frustration
Need-based experiences				
Autonomy satisfaction				
Raw scores (1-5)	3.67(0.08)	3.11(0.07)	3.10(0.11)	2.27(0.10)
Z–scores	0.41(0.08)	-0.12(0.07)	-0.13(0.11)	-0.92(0.10)
Competence satisfaction				
Raw scores (1-5)	4.03(0.07)	3.44(0.08)	3.30(0.12)	2.74(0.11)
Z–scores	0.44(0.07)	-0.30(0.08)	-0.16(0.13)	-0.88(0.11)
Relatedness satisfaction				
Raw scores (1-5)	4.33(0.05)	3.77(0.07)	3.71(0.10)	1.16(0.02)
Z–scores	0.42(0.05)	-0.30(0.07)	-0.27(0.12)	-0.56(0.02)
Autonomy frustration				
Raw scores (1-5)	1.87(0.04)	2.04(0.06)	3.03(0.32)	3.48(0.11)
Z–scores	-0.51(0.04)	-0.55(0.06)	0.50(0.28)	0.94(0.10)
Competence frustration				
Raw scores (1-5)	1.47(0.03)	2.17(0.19)	2.64(0.07)	3.09(0.14)
Z–scores	-0.47(0.03)	-0.54(0.19)	0.45(0.07)	1.06(0.14)
Relatedness frustration				
Raw scores (1-5)	1.12(0.01)	2.09(0.03)	2.73(0.07)	3.34(0.08)
Z–scores	-0.49(0.01)	-0.60(0.03)	0.39(0.08)	2.01(0.08)
Outcomes in PE				
Autonomous motivation (1–7)	5.70(0.04)^{2a,3a,4a}	4.73(0.10)^{1a,3c,4a}	4.46(0.15)^{1a,2c,4a}	3.95(0.12)^{1a,2a,3b}
Controlled motivation (1–7)	3.06(0.06)^{2a,3a,4a}	3.83(0.10)^{1a,3b}	4.36(0.16)^{1a,2b,4b}	3.82(0.10)^{1a,3b}
Amotivation (1–7)	1.39(0.04)^{2a,3a,4a}	2.52(0.11)^{1a,3c,4c}	2.83(0.12)^{1a,2c,4c}	3.13(0.15)^{1a,2b,3c}
PE experiences (1–5)	4.37(0.03)^{2a,3a,4a}	4.03(0.06)^{1a,4c}	4.02(0.10)^{1a,4c}	3.81(0.08)^{1a,2c,3c}
Oppositional defiance (1–5)	1.66(0.03)^{2a,3a,4a}	2.09(0.06)^{1a,4c}	2.21(0.09)^{1a}	2.28(0.08)^{1a,2c}
Outcomes outside of PE				
PA intention (1–7)	5.68(0.06)^{2a,3a,4a}	4.58(0.14)^{1a}	4.32(0.21)^{1a}	4.31(0.15)^{1a}
MVPA (min)	68.72(33.56)^{2b,3a,4a}	44.99(23.45)^{1a}	32.51(23.58)^{1a}	31.18(23.04)^{1a}
PA recommendations (yes)	42.20%(0.02)^{2a,3a,4a}	19.50%(0.03)^{1a}	15.50%(0.05)^{1a}	14.70%(0.04)^{1a}

Note. PE: Physical education; PA: Physical activity; MVPA: Moderato-to-vigorous physical activity. Numbers in superscript indicate significant group differences. $^{a}p<.001$, $^{b}p<.010$, $^{c}p<.050$

Figure 1

Description of the four need satisfaction and frustration latent profiles based on raw (upper side) and standardized (lower side) scores