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Title: Including the construct of novelty in a full sequential model of the bright side of self-determination theory in physical education

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Abstract:

The aim of this study was to incorporate the construct of novelty into the sequential model proposed by self-determination theory, analyzing the paths between teachers' need support in physical education and students' need satisfaction, autonomous motivation, and intention to be physically active. Participants in this cross-sectional study were 888 secondary school students (472 girls), aged between 11 and 17 years (M = 13.15). Results from the final structural equation model showed that each type of teacher need support (i.e. autonomy, competence, relatedness, and novelty) was most strongly associated with the satisfaction of its respective need in students. Moreover, teachers' competence and relatedness support were positively associated with novelty satisfaction. Only competence and novelty satisfaction were positively related to students' autonomous motivation, which, in turn, was positively associated with their intention to be physically active. These findings provide further evidence for considering novelty from a self-determination theory perspective.

Keywords: Need-supportive teaching style, basic psychological needs, motivation, physical activity, explanatory role.

Introduction

Self-determination theory (SDT) (Deci & Ryan, 1985; Ryan & Deci, 2017), an empirical macro-theory of human motivation, posits the existence of three basic psychological needs (BPNs) within one of its six mini-theories, the BPNs theory. These BPNs are recognized as psychological nutrients essential to individuals' adjustment, integrity, and growth (Ryan, 1995). The needs established by SDT are autonomy, which is characterized by the experience of volition, willingness, and authenticity in one's actions, thoughts, and feelings; relatedness, which pertains to the experience of warmth, bonding, and care, and is fulfilled when feeling connected to significant others; and competence, which involves the experience of effectiveness and mastery (Vansteenkiste et al., 2023). The SDT sequential model (Vasconcellos et al., 2020) establishes that the social context affects BPN satisfaction or frustration. In turn, this satisfaction or frustration will have an impact on human motivation and its consequences (Ryan & Deci, 2020). From an organismic SDT perspective, physical activity (PA) can be understood as a natural expression of vitality and human flourishing (Ryan, 2025). For instance, BPN satisfaction in physical education is associated with students' autonomous motivation (Kelso et al., 2020) and adaptive consequences such as positive emotions and the intention to be physically active (e.g. Castillo et al., 2020; Fierro-Suero et al., 2023). On the other hand, BPN frustration is associated with maladaptive outcomes such as amotivation, disinterest, or sedentary behaviors (White et al., 2021).

Physical education potentially plays a fundamental role in promoting healthy lifestyles and students' well-being (Kalajas-Tilga et al., 2020). In some cases, it represents the only guaranteed opportunity for all young people to engage in PA. Moreover, it can offer a structured environment in which students can acquire motor skills and have opportunities to develop motivational dispositions and attitudes that might, under certain conditions, extend to extracurricular sport and exercise participation. Teachers are among the most influential actors in the educational context (Braithwaite et al., 2011) and can support or thwart students' BPNs. The teacher's interpersonal style depends on how educational aspects are managed, including goal-setting, approach to corrections, or interaction with students (Ryan & Deci, 2017). For example, an autonomy-supportive style is characterized by attempts to identify students' interests and preferences and providing choice (Aelterman et al., 2019; Patall et al., 2010; Reeve, 2009). Competence support refers to how teachers organize and deliver activities by providing clear expectations, consistent contingencies, efficacy-relevant feedback, help when needed, and ongoing monitoring during the lesson (Vasconcellos et al., 2020), while a relatedness-supportive style refers to promoting authentic and supportive relationships (Reeve & Jang, 2006). Thus, when teachers establish a need-supportive interpersonal style, students' motivation, engagement, and learning improve (Cheon et al., 2018, 2020; Reeve & Cheon, 2021). Conversely, when a teacher adopts a need-thwarting interpersonal style, students' motivation tends to be more controlled, fear of failure increases, and engagement decreases (Vasconcellos et al., 2020).

The incorporation of new BPNs into SDT is a topic of ongoing debate among researchers in motivational psychology (Vansteenkiste et al., 2020, 2023). As various new candidate needs have been proposed over the last decade, the criteria that BPNs should meet have been

reviewed and discussed among specialists in this theory (Ryan & Deci, 2017; Vansteenkiste et al., 2020, 2023). Ryan and Deci (2017) specified six criteria that were expanded to nine later (Vansteenkiste et al., 2020, 2023): 1) Essential; 2) Psychological; 3) Pervasive; 4) Universal; 5) Inherent; 6) Distinct; 7) Content-specific; 8) Directional; 9) Explanatory (for further information see Ryan & Deci, 2017; Vansteenkiste et al., 2020, 2023). Various studies conducted thus far have shown that novelty may fulfil some of these criteria (Bagheri & Milyavskaya, 2020; González-Cutre, Brugarolas-Navarro, et al., 2025; González-Cutre et al., 2016, 2020; Kosa & Uysal, 2024). However, other criteria (Vansteenkiste et al., 2020, 2023) still require attention, as incorporating novelty as a new BPN represents a lengthy journey that has only just commenced (González-Cutre et al., 2016).

Novelty is defined as the need to experience something not previously experienced or that differs from everyday routine (González-Cutre et al., 2016). One of the main areas where studies on novelty have been developed is physical education. In the research conducted so far in this context, the relationships between novelty and different outcomes were in line with previous research on the three BPNs established in SDT. In this regard, novelty satisfaction was positively related to students' autonomous motivation (Fernández-Espínola et al., 2020; Fierro-Suero, Almagro, Sáenz-López, et al., 2020; González-Cutre & Sicilia, 2019), vitality and flow (González-Cutre & Sicilia, 2019), emotions such as enjoyment and pride (Fierro-Suero, Almagro, & Sáenz-López, 2020; Fierro-Suero et al., 2024), and the intention to be physically active (Aibar et al., 2021). Conversely, novelty frustration has been associated with students' amotivation, lack of concentration, and boredom (González-Cutre, Brugarolas-Navarro, et al., 2025), among other consequences.

Although the outcomes arising from novelty satisfaction and frustration have received considerable attention in recent years, the impact of social factors on the novelty experience has not been examined to a similar degree. In this sense, it has been observed that physical education teachers' autonomy, competence, and relatedness support predicted students' novelty satisfaction (Aibar et al., 2021). However, little is currently known about the role that a novelty-supportive/thwarting teaching style plays in physical education in the eyes of students. A novelty-supportive style emerges when teachers propose activities that are unusual for students, introduce alternative content rather than the traditional one, use different materials, or implement innovative methodologies (Fierro-Suero, Almagro, Sáenz-López, et al., 2020). To our knowledge, only two studies have evaluated the effect of teacher novelty support and both were in a physical education context (Fierro-Suero, Almagro, Sáenz-López, et al., 2020; Fierro-Suero et al., 2024). However, none of these studies measured autonomy, competence, and relatedness support from the teacher. Accordingly, the interaction between novelty support and the other basic needs support could not be assessed. Therefore, the present study aimed to examine whether including the need for novelty within the full bright-side sequence of SDT improves the explanatory power of the model in physical education. From these previous works, it was concluded that teacher novelty support predicted not only novelty satisfaction (Fierro-Suero, Almagro, Sáenz-López, et al., 2020; Fierro-Suero et al., 2024), but also autonomy, competence, and relatedness satisfaction (Fierro-Suero, Almagro, Sáenz-López, et al., 2020). Furthermore, novelty support had a

direct effect on students' intrinsic motivation, as well as an indirect effect via BPN satisfaction and novelty satisfaction (Fierro-Suero, Almagro, Sáenz-López, et al., 2020).

Among the various outcomes linked to motivation for physical education, the intention to be physically active has been one of the most extensively examined (Vasconcellos et al., 2020), particularly in studies focused on the construct of novelty in physical education (e.g. Aibar et al., 2021; Fernández-Espínola et al., 2020; Fierro-Suero et al., 2024). This variable is understood as a proximal antecedent and a robust predictor of actual PA behavior (Ajzen, 2020). For this reason, it was considered a central outcome in the present study to evaluate the potential impact of motivational processes fostered through need-supportive teaching.

Based on the criteria cited previously for establishing new BPNs and the research conducted thus far, it was deemed necessary to undertake the first study that included novelty in the full sequential model of the bright side of SDT (need support → need satisfaction → motivation → outcomes; Vasconcellos et al., 2020) together with the three BPNs. Therefore, this study aimed to examine the role of novelty support and novelty satisfaction in physical education. Specifically, it explored whether and how these variables help explain students' autonomous motivation and their intention to be physically active. To achieve this objective, two models were tested: a) a traditional model with the three classic BPNs, and b) an extended model that also included novelty support and novelty satisfaction. This comparison was intended to evaluate whether novelty shows core features of a candidate BPN—namely, (1) a content-based nature (i.e. whether novelty support relates to novelty satisfaction through students' novelty-related experiences, such as engaging in new activities), (2) a distinct role (i.e. whether novelty-related experiences and novelty satisfaction operate differently from, and add to, the three established needs), and (3) incremental explanatory value (i.e. whether adding novelty improves the model's ability to account for autonomous motivation and PA intention) (Vansteenkiste et al., 2023). In line with the SDT sequential model, we hypothesized that teachers' need support would positively predict students' need satisfaction with each type of support showing the strongest association with its corresponding need satisfaction (e.g. novelty support predicting novelty satisfaction). Need satisfaction would positively predict students' autonomous motivation, which in turn would positively predict their intention to be physically active (Figure 1).

Figure 1

Method

Participants

The participants in this study were 888 secondary school students, 414 (46.62%) boys, 472 (53.15%) girls, and 2 (0.23%) who preferred not to say, aged between 11 and 17 years (M = 13.15; SD = 1.17). This age range was selected because it spans the full length of compulsory secondary education in Spain. The selection of participants was based on schools' willingness to participate in the study, resulting in a non-probabilistic sample. Five secondary schools (public and private) agreed to participate in the study; all were in the south-western region of Spain. The sample was distributed across the four grades of

mandatory secondary education as follows: 280 (31.53%) first graders, 327 (36.82%) second graders, 222 (25%) third graders, and 59 (6.65%) fourth graders. A total of seven teachers taught 40 classes. Physical education lessons were conducted twice a week, each session lasting 60 minutes. The physical education curriculum, in accordance with Spanish educational law, focused on teaching games and sports, corporeal expression, the development of physical and motor skills, health and quality of life enhancement, and physical activities in natural environments.

Measures

Basic psychological needs support. We used a scale composed of 12 items from the Support for Basic Psychological Needs in Physical Education Questionnaire (Sánchez-Oliva et al., 2013) and four items developed by Fierro-Suero, Almagro, Sáenz-López, et al. (2020) to measure novelty support. Items are preceded by the stem "In my physical education class, the teacher..." and measure autonomy support (e.g. "Often asks about the activities to be carried out"), competence support (e.g. "Comes up with activities tailored to our skills"), relatedness support (e.g. "Helps us to resolve conflicts amicably"), and novelty support (e.g. "Often proposes new activities"). The responses to the items are given on a Likert-type scale from 1 (*strongly disagree)* to 5 (*strongly agree*). In this research, the four-factor correlated model obtained a good fit to the observed data: $\chi^2 = 277.211$, $df = 98$, $p < .001$, $\chi^2 / df = 2.829$, CFI = .978, TLI = .974, SRMR = .027, RMSEA = .045 (90%CI = .039 – .052).

Basic psychological needs satisfaction. We used 12 items from the Spanish version of the Basic Psychological Needs in Exercise Scale adapted to physical education (Moreno et al., 2008; Vlachopoulos & Michailidou, 2006) and five items from the Novelty Need Satisfaction Scale (González-Cutre & Sicilia, 2019; González-Cutre et al., 2016). The scale begins with the stem "In my physical education class" and includes items to measure autonomy satisfaction (e.g. "I have the opportunity to choose how to perform the exercises"), competence satisfaction (e.g. "I feel that exercise is an activity in which I do very well"), relatedness satisfaction (e.g. "I feel very comfortable with my classmates"), and novelty satisfaction (e.g. "I frequently feel there are novelties for me"). Participants rated each item on a five-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). In this research, the four-factor correlated model obtained a good fit to the observed data: $\chi^2 = 358.128$, $df = 98$, $p < .001$, $\chi^2 / df = 3.654$, CFI = .976, TLI = .971, SRMR = .056, RMSEA = .055 (90%CI = .049 – .060).

Autonomous motivation. To evaluate autonomous motivation, the Spanish adaptation (Ferriz et al., 2015) of the Perceived Locus of Causality Scale (Goudas et al., 1994) was employed. This instrument commences with the sentence "I take part in physical education" and comprises 12 items divided into three subscales, each containing four items: intrinsic regulation (e.g. "Because physical education is fun"), integrated regulation (e.g. "Because it is in line with my way of life"), and identified regulation (e.g. "Because I want to learn sports skills"). Responses are recorded on a 7-point Likert scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Autonomous motivation was calculated by averaging the items from intrinsic motivation, integrated regulation, and identified regulation. This operationalization

is consistent with SDT's motivation taxonomy, in which intrinsic, integrated, and identified regulations reflect more autonomous forms of motivation (Ryan & Deci, 2020). In this research, the one-factor model had a good fit to the observed data: $\chi^2 = 242.673$, $df = 54$, $p < .001$, $\chi^2 / df = 4.494$, CFI = .983, TLI = .979, SRMR = .028, RMSEA = .064 (90%CI = .056 – .073).

Intention to be physically active. The intention to engage in PA was assessed using four items (e.g. "I would like to be physically active") from the Spanish version of the Intention to be Physically Active Scale (Hein et al., 2004; Moreno et al., 2007). Items were introduced with the stem "Regarding my intention to practice sport or PA in my free time". Participants responded to the items on a Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). In this research, the four-item factor model had a good fit to the observed data: $\chi^2 = 12.478$, $df = 4$, $p < .001$, $\chi^2 / df = 3.120$, CFI = .993, TLI = .982, SRMR = .018, RMSEA = .049 (90%CI = .020 – .080).

Procedure

The study was conducted in line with the ethical guidelines of the American Psychological Association (2020) and received approval from the Andalusian Ethics Committee for Biomedical Research (TD-OCME-2018). Initially, the researchers reached out to school administrators and boards to inform them about the study and request their collaboration. Five secondary schools agreed to participate. As the participants were minors, written informed consent was obtained from their parents or legal guardians.

The data collection took place during school hours, and the questionnaires were administered in a classroom setting. A member of the research team was present to provide a brief explanation, ensure the smooth progression of the process, and answer any questions the students might have had. Participation was both anonymous and voluntary, and completing the questionnaire took approximately 25-30 minutes. To maintain data integrity, students who completed the questionnaire significantly faster than the average time were excluded from the analysis (n = 4; 0.45% of the initial sample).

Data analysis

As a preliminary step, confirmatory factor analyses were conducted to gather validity evidence based on the internal structure of each instrument used. Next, McDonald's omega coefficients were estimated with values above .70 as representative of good reliability. Latent correlations from the measurement model were also computed, with values as high as .85, indicating the absence of multicollinearity among variables (Kline, 2016). To ensure the trustworthiness of the results of the structural equation modelling (SEM) approach to be tested, a minimum sample size of 550 participants was estimated in accordance with Westland's (2010) recommendations. Before the two-step SEM, the intraclass correlation coefficient (ICC) was calculated to assess hierarchical structure within teachers delivering physical education lessons. ICC values above .10 indicate the need to account for the hierarchical nature of the data (Preacher et al., 2011). In such cases, and consistent with previous research (Santana-Monagas et al., 2024), the clustering of data at the teacher level

was controlled for by specifying "type=complex". On the other hand, descriptive statistics, including means and standard deviations, were calculated.

To analyse the direct and indirect paths from students' perceptions of teacher need support to their PA intention via need satisfaction and autonomous motivation, two models were tested. The first model included only three types of teachers' need support and the satisfaction of the three BPNs, while the second model added teacher novelty support and students' novelty satisfaction. Both models were performed using a two-step SEM approach (Kline, 2016). In the first step, the robustness of the measurement models (i.e. all target variables were freely correlated) was examined. In the second step, a predictive model was tested by examining the paths from teachers' need support to PA intention via need satisfaction and autonomous motivation. They were estimated using the maximum likelihood robust (MLR) estimator because it gathers fit and standard error rates that are robust to non-normality and suitable for Likert scales with five or more response choices (Muthén & Muthén, 1998-2017). The goodness of the models' fit was assessed using values of up to 3 for the coefficient between chi-squared and degrees of freedom (χ^2/df), greater than .95 for the Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI), and as high as .060 for the Standardized Root Mean Square Residual (SRMR) and the Root Mean Square Error of Approximation (RMSEA) (Kline, 2016). In addition to direct paths ($p \leq .05$), indirect paths were examined following Hayes' (2021) recommendations, whereby an indirect (i.e. mediating) effect is considered significant when its 95% confidence interval (95% CI) does not contain zero. Students' sex and age were included as covariates, in line with previous meta-analytic research (Vasconcellos et al., 2000) and given documented sex and age differences in the study variables (see Appendix). All analyses were run using Jamovi version 2.6.44 and Mplus version 8.0 (Muthén & Muthén, 1998-2017).

Results

Preliminary analysis

Table 1 shows that the average scores for each of the ten variables under study were higher than the midpoint of their respective measurement scales. McDonald's omega scores were between .77 and .95, which gathered evidence for reliability. Moreover, latent correlations ranged from .26 to .85, indicating the absence of multicollinearity. More specifically, PA intention was positively correlated with all variables, showing the strongest correlation with competence satisfaction and autonomous motivation.

Table 1

Multilevel structural equation modelling approach

Prior to SEM, Table 1 reports ICC values ranging from .04 to .27, with 8 of the 10 variables exceeding .10. This indicated that students were clustered by teacher (i.e. students were taught by different physical education teachers), and, therefore, that the analyses needed to account for clustering at the teacher level.

In the first of the two steps of multilevel SEM, the robustness of the measurement model was examined both for the model excluding novelty-related variables (χ^2 = 2194.367, *df* = 832, χ^2 / *df* = 2.703, CFI = .962, TLI = .958, SRMR = .057, RMSEA = .043, 90%CI = .041 – .045), and the model including the novelty-related variables (χ^2 = 2809.461, *df* = 1229, χ^2 / *df* = 2.286, CFI = .966, TLI = .963, SRMR = .052, RMSEA = .037, 90%CI = .035 – .039).

In the second step of the multilevel SEM, the predictive structural model obtained an acceptable fit to the observed data both for the model excluding novelty (χ^2 = 2240.534, *df* = 829, χ^2 / *df* = 2.703, CFI = .960, TLI = .957, SRMR = .056, RMSEA = .044, 90%CI = .042 – .046), and the model including novelty (χ^2 = 2837.108, *df* = 1227, χ^2 / *df* = 2.312, CFI = .965, TLI = .962, SRMR = .054, RMSEA = .038, 90%CI = .037 – .040). Overall, the goodness-of-fit indexes slightly improved when novelty support and novelty satisfaction were included. The standardized parameter estimates and the explained variances (R^2) for both models are shown in Figure 2.

Figure 2

In the model excluding novelty-related variables (see Figure 2a), each of the three types of teachers' need support was most strongly associated with the satisfaction of its respective need in students, with paths ranging from .31 (i.e. autonomy-support → autonomy satisfaction) to .84 (relatedness support → relatedness satisfaction). However, there were also cross-paths from teachers' competence and relatedness support to autonomy satisfaction, as well as from competence support to relatedness satisfaction. Furthermore, autonomy and competence satisfaction were positively associated with autonomous motivation (β = .47, $p < .001$; β = .39, $p < .001$), while relatedness satisfaction was unrelated. Autonomous motivation, in turn, was positively related to PA intention (β = .60, $p < .001$). This model accounted for 48% of the explained variance in PA intention.

When the two novelty-related variables were included in the model (see Figure 2b), a similar pattern emerged for the direct paths from teachers' need support to students' need satisfaction. Teacher's novelty support was strongly associated with novelty satisfaction (β = .89, $p < .001$) and was also related to autonomy satisfaction (β = .21, $p = .027$). The inclusion of teachers' novelty support reduced the strength of the paths between teachers' competence and relatedness support and autonomy satisfaction (from .64, $p < .001$ to .40, $p < .001$ and from −.24, $p = .034$ to −.11, $p = .079$, respectively). In addition, teacher competence and relatedness support were positively related to novelty satisfaction (β = .25, $p = .009$; β = .20, $p = .035$). Following the motivational sequence, novelty satisfaction was positively related to autonomous motivation (β = .39, $p < .001$), while the association between competence satisfaction and autonomous motivation increased (β = .49, $p < .001$), and the association between autonomy satisfaction and autonomous motivation became non-significant (β = .08, $p = .612$). Akin to the previous model, relatedness satisfaction was unrelated to autonomous motivation. Finally, autonomous motivation remained positively associated with PA intention (β = .61, $p < .001$). With the inclusion of the two novelty-related

variables, the explained variance increased from 68% to 71% for autonomous motivation and from 48% to 53% for PA intention.

Table 2 shows the indirect effects of each type of teacher need support on PA intention through need satisfaction and autonomous motivation for both models.

Table 2

Discussion

The objective of this study was to incorporate the construct of novelty into the complete sequence of the bright side of SDT, analyzing the paths between teachers' need support for physical education and students' need satisfaction, autonomous motivation, and intention to be physically active. This is the first study to include novelty support and novelty satisfaction alongside the support and satisfaction of the three BPNs established by SDT (autonomy, competence, and relatedness). The findings support the idea that novelty, when conceptualized as a BPN (Bagheri & Milyavskaya, 2020; González-Cutre et al., 2016, 2020), contributes meaningfully to the explanation of motivational processes in physical education. Comparing the two models tested (with and without novelty constructs), the present study found that including teachers' novelty support and students' novelty satisfaction slightly increased the explained variances for students' need satisfaction (except for autonomy), autonomous motivation and PA intention. However, more importantly, the associations between the types of need support, need satisfaction, and autonomous motivation were modified, particularly the relationship between autonomy satisfaction and autonomous motivation, which showed reduced predictive strength. This reduction is consistent with previous research that included novelty in SDT-based models in physical education (Aibar et al., 2021; González-Cutre, Brugarolas-Navarro, et al., 2025; González-Cutre & Sicilia, 2019; González-Cutre et al., 2016) and in other contexts (González-Cutre et al., 2020). These findings point out that if novelty was not included in the models, autonomy and competence could absorb the effect of this variable. This may prevent a complete understanding of students' motivation and the necessary strategies that teachers should implement to improve it. Novelty support and novelty satisfaction may reflect a motivationally relevant component that has not been explicitly modelled previously and has therefore been subsumed under other need-supportive behaviors and BPN satisfaction. The inclusion of novelty led to a redistribution of shared explained variance, allowing for a more precise understanding of the pathways linking teachers' instructional behaviors to students' autonomous motivation and related outcomes, and revealing meaningful modifications in the motivational sequence. When researchers and teachers think about autonomy- and competence-supportive practices, they may not routinely consider novelty-supportive practices. Given that novelty emerged as distinct from the three established needs and showed differential associations in the present study, incorporating novelty-support into SDT-informed practice could help further refine need-supportive processes in physical education.

Specifically, we found that novelty support positively predicted novelty and autonomy satisfaction. When teachers implement novel tasks, content, or teaching styles, use varied and innovative materials, conduct activities in different spaces, or explain content in creative

ways, students' novelty satisfaction is more likely to be fostered. Moreover, the inclusion of novelty support in an autonomy-supportive way could help to promote autonomy satisfaction. This would happen when students harmoniously internalize the novelties they receive from the environment. Therefore, applying novelty-supportive techniques (González-Cutre, Ferriz, & Jiménez-Loaisa, 2025) alongside support for the three BPNs (Ahmadi et al., 2023) could be advisable to trigger a positive motivational process in physical education.

Fierro-Suero, Almagro, Sáenz-López, et al. (2020) found the same results, although novelty support also positively predicted competence and relatedness satisfaction. Nevertheless, they did not include the support for the three BPNs in their model. When we estimated the full model simultaneously, including all four types of need support, we found a more parsimonious distribution of effects, with each type of need support showing its strongest association with the corresponding need satisfaction. This finding supports the idea that all BPNs should go hand in hand (Ryan & Deci, 2017).

Continuing with the analysis of the SDT sequential model, and focusing on the construct of novelty, we found that novelty satisfaction was also positively predicted by relatedness support and competence support. Similar results were reported by Aibar et al. (2021), but they did not include novelty support in their analysis and grouped the satisfaction of the three BPNs into a single latent variable. The present study extends previous research and explains 68% of the variance in novelty satisfaction, compared to the 31% explained by Aibar et al. (2021). The opportunity to experience new and diverse social interactions in a relatedness-supportive context (Kristensen et al., 2025), together with the support for new learning opportunities through clear structure, goals and feedback (competence support), could also promote the students' satisfaction of their need for novelty in physical education.

Novelty satisfaction positively predicted students' autonomous motivation together with competence satisfaction. In line with a previous meta-analysis (Vasconcellos et al., 2020), the development of students' competence seems to be a key aspect to encourage positive motivation in physical education. However, novelty satisfaction stands out as the second predictor of autonomous motivation in the present study and past research (Fierro-Suero, Almagro, Sáenz-López, et al, 2020; González-Cutre & Sicilia, 2019; González-Cutre et al., 2016). One study even reported that, during the changes experienced in physical education classes due to the COVID-19 pandemic, novelty satisfaction showed a stronger association with autonomous motivation than the satisfaction of the three BPNs (Hsu et al., 2023). By contrast, another study highlighted autonomy satisfaction as a key predictor of autonomous motivation and suggested that it should be considered alongside competence and novelty satisfaction in physical education (Koka et al., 2021). Therefore, the consideration of the three BPNs along with the need for novelty seems fundamental to explain students' motivation in this context and to promote their intention to participate in extracurricular PA.

The results of this study, in addition to providing a motivational model of students' intention to be physically active, offered support for some of the less frequently addressed criteria (Vansteenkiste et al., 2023) for including novelty as a new BPN within SDT. The inclusion

of novelty support in the SDT sequential model tested in the present study showed that there are specific novelty-supportive behaviors and experiences that contribute to need satisfaction (novelty and autonomy satisfaction in this case), thereby reflecting the *content-based nature* of novelty. Novelty support showed the strongest association with novelty satisfaction, even after controlling for the other three types of teachers' need support. Moreover, these novelty-related experiences differed from those associated with autonomy, competence, and relatedness satisfaction, explaining additional variance in autonomous motivation beyond the three traditional needs and showing the *distinct role* of novelty. Finally, the present study demonstrated the *explanatory role* of novelty showing that variations in novelty-related features of the social context explained motivation and adaptive consequences in physical education. Overall model fit and explained variance improved when novelty was included. These findings reinforce the conceptual relevance of novelty within SDT and highlight its potential value for enhancing motivational strategies in physical education.

This study has several limitations that should be considered when interpreting the findings. First, the sample consisted exclusively of students from Spain, which may introduce cultural or contextual biases and limit the generalizability of the results to other educational or cultural settings. Second, the cross-sectional design precludes any causal conclusions regarding the relationships among the variables. Third, data were collected through self-report questionnaires, which may be subject to social desirability bias or individual interpretation. Finally, although all measurement instruments demonstrated acceptable psychometric properties, the inherent limitations of the scales used (such as the number of items or context-specific adaptation) should be acknowledged.

Future research should examine the longitudinal effects of novelty-supportive and novelty-thwarting environments on a range of positive and negative outcomes in physical education, to replicate and extend the present cross-sectional findings and to further explore the “dark side” of SDT. Likewise, to date, there is still a lack of person-centred research examining novelty in the same way that BPNs have been studied in recent years (e.g. Burgueño et al., 2023), which could help identify meaningful motivational profiles characterised by different combinations of novelty satisfaction and frustration and their links to adaptive and maladaptive outcomes. Furthermore, the implementation of novelty-supportive practices by the physical education teacher (see González-Cutre, Ferriz, & Jiménez-Loaisa, 2025) should be analyzed within school-based interventions to promote PA. In this regard, it would be helpful to compare the effects of motivational interventions that include strategies targeting traditional BPNs with those that explicitly incorporate novelty-supportive strategies, to better understand the additional contribution of novelty-focused approaches. Moreover, determining the “optimal dose” of novelty remains an important future goal; therefore, randomized controlled trials systematically testing different novelty-support strategies would be crucial for identifying their optimal intensity and combination (González-Cutre, 2025). The exploration of novelty as a potential BPN should continue across various cultures, contexts, and life stages, building on past decade's research to determine whether it exhibits universal and inherent traits, as well as a proactive (growth-oriented) nature.

In conclusion, as far as we are aware, this study was the first that showed the significant role of novelty support and novelty satisfaction in the complete sequence of the bright side of SDT in physical education. Including these constructs in the model provided a more complete explanation of the relations between teachers' behaviors and students' motivational functioning. Teachers' novelty support positively predicted students' novelty and autonomy satisfaction. Novelty and competence satisfaction positively predicted students' autonomous motivation that in turn positively predicted their intention to be physically active. The present study also allowed us to explore further the inclusion criteria to consider novelty as a BPN. Although more research is needed on this topic, the evidence so far shows that novelty is a variable that should be considered from the SDT perspective.

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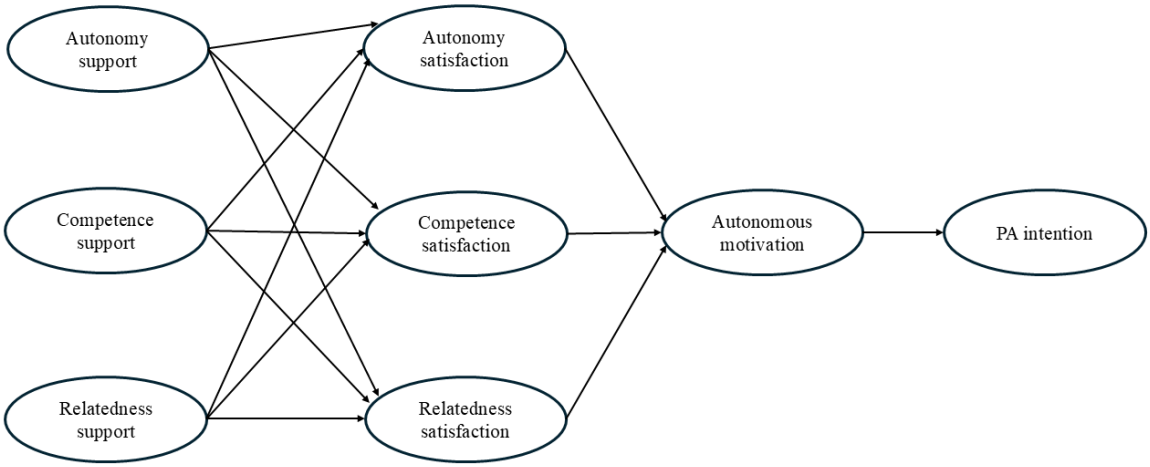

Figure 1a. Hypothesized model excluding novelty support from the teacher and students' novelty satisfaction.

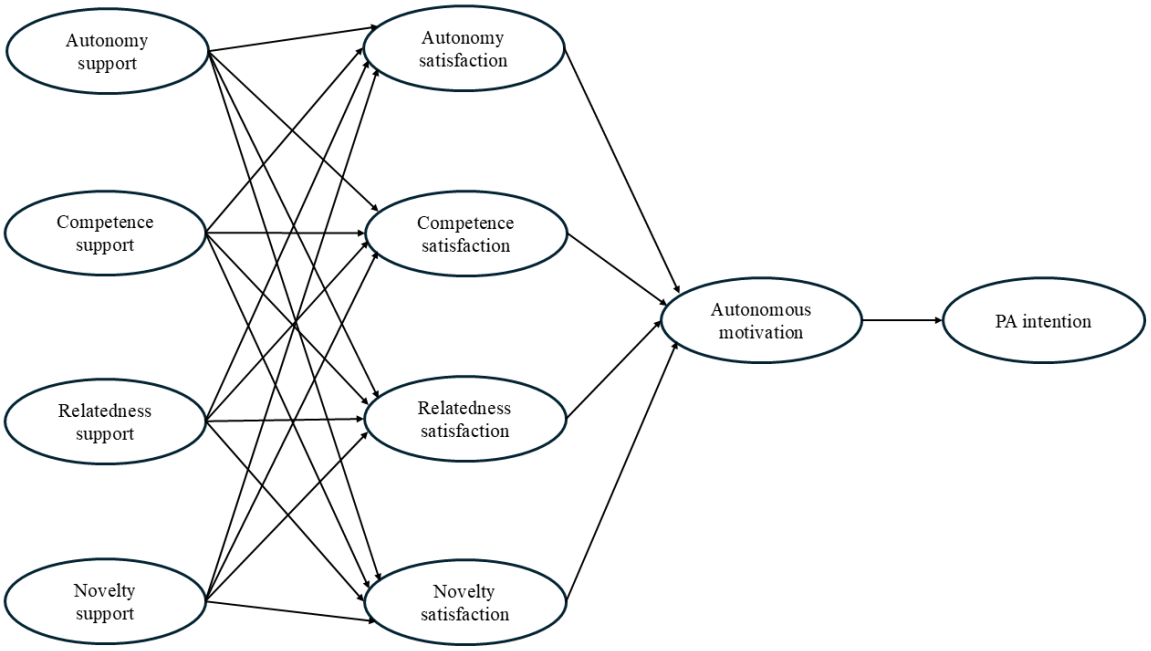

Figure 1b. Hypothesized model including novelty support from the teacher and students' novelty satisfaction.

Figure 1. Hypothesized relationships between teachers' need support, students' need satisfaction, autonomous motivation, and intention to be physically active.

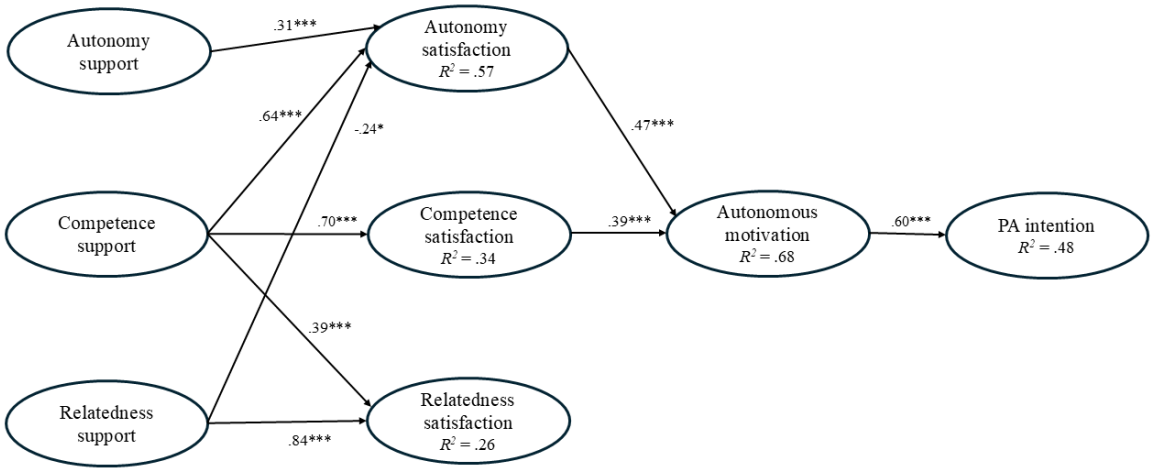

Figure 2a. Model excluding novelty support from the teacher and students' novelty satisfaction.

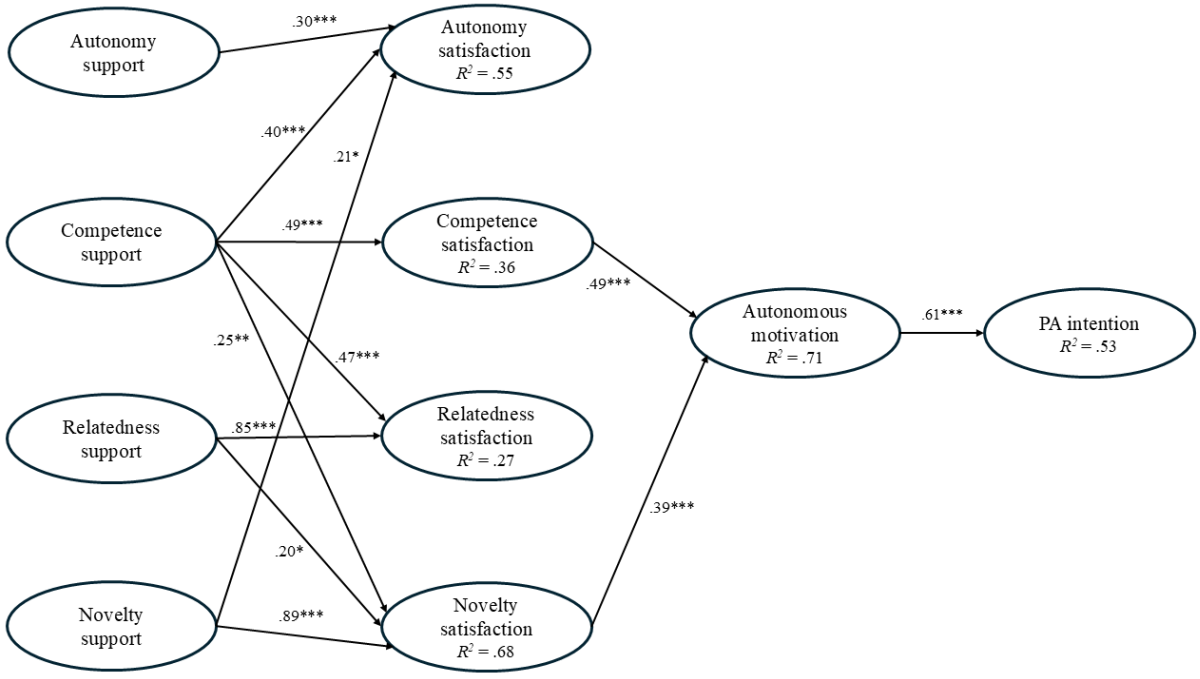

Figure 2b. Model including novelty support from the teacher and students' novelty satisfaction.

Figure 2. Structural equation modelling of students' perceptions of need support from the teacher, their need satisfaction, autonomous motivation, and intention to be physically active, considering the inclusion and exclusion of novelty-related variables. ***$p < .001$, **$p < .01$, *$p < .05$.

Table 1. Descriptive statistics, reliability coefficients, and latent correlations among study variables.

Variable	1	2	3	4	5	6	7	8	9	10
1. Autonomy Support	-									
2. Competence Support	.84	-								
3. Relatedness Support	.76	.81	-							
4. Novelty Support	.85	.80	.79	-						
5. Autonomy Satisfaction	.70	.69	.58	.70	-					
6. Competence Satisfaction	.39	.50	.45	.42	.71	-				
7. Relatedness Satisfaction	.28	.33	.47	.30	.42	.59	-			
8. Novelty Satisfaction	.66	.71	.58	.80	.83	.56	.46	-		
9. Autonomous Motivation	.54	.69	.57	.64	.74	.75	.47	.71	-	
10. PA Intention	.26	.37	.34	.33	.51	.74	.39	.40	.73	-
Range	1–5	1–5	1–5	1–5	1–5	1–5	1–5	1–5	1–7	1–5
Mean	3.04	3.92	4.02	3.51	3.02	3.78	4.19	3.48	5.32	4.18
Standard Deviation	1.04	.95	.94	1.06	.92	.88	.87	.92	1.33	.83
Coefficient ω	.83	.82	.86	.86	.79	.80	.84	.86	.95	.77
ICC	.22	.23	.23	.27	.10	.05	.10	.14	.11	.04

Note: All the correlations were significant ($p < .001$). PA = Physical activity. ICC = Intraclass correlation coefficient.

Table 2. Standardized indirect effects from need support to PA intention through need satisfaction and autonomous motivation

	Model without novelty	Model with novelty
	β (95%CI)	β (95%CI)
Indirect effect of teachers' autonomy support on PA intention		
Total indirect effects	.051 (-.066; .169)	-.057 (-.198; .084)
Specific indirect via autonomy satisfaction and autonomous motivation	.093 (.019; .167)	.014 (-.037; .066)
Specific indirect via competence satisfaction and autonomous motivation	-.040 (-.086; .006)	-.034 (-.097; .030)
Specific indirect via relatedness satisfaction and autonomous motivation	-.001 (-.008; .006)	.002 (-.001; .004)
Specific indirect via novelty satisfaction and autonomous motivation	–	-.039 (-.131; .052)
Indirect effect of teachers' competence support on PA intention		
Total indirect effects	.355 (.179; .531)	.320 (.082; .558)
Specific indirect via autonomy satisfaction and autonomous motivation	.191 (.110; .271)	.019 (-.062; .100)
Specific indirect via competence satisfaction and autonomous motivation	.175 (.059; .291)	.232 (.026; .438)
Specific indirect via relatedness satisfaction and autonomous motivation	-.011 (-.027; .005)	.009 (-.015; .034)
Specific indirect via novelty satisfaction and autonomous motivation	–	.059 (-.029; .148)
Indirect effect of teachers' relatedness support on PA intention		
Total indirect effects	-.046 (-.205; .113)	-.083 (-.246; .080)
Specific indirect via autonomy satisfaction and autonomous motivation	-.060 (-.104; -.016)	-.008 (-.038; .022)
Specific indirect via competence satisfaction and autonomous motivation	-.010 (-.110; .091)	.009 (-.131; .113)
Specific indirect via relatedness satisfaction and autonomous motivation	.023 (-.028; .075)	-.017 (-.050; .016)
Specific indirect via novelty satisfaction and autonomous motivation	–	-.049 (-.103; .005)
Indirect effect of teachers' novelty support on PA intention		
Total indirect effects	–	.259 (.077; .380)
Specific indirect via autonomy satisfaction and autonomous motivation	–	.010 (-.031; .052)
Specific indirect via competence satisfaction and autonomous motivation	–	.039 (-.182; .104)
Specific indirect via relatedness satisfaction and autonomous motivation	–	-.002 (-.010; .006)
Specific indirect via novelty satisfaction and autonomous motivation	–	.210 (.050: .370)

Appendix

Sex and age differences for the variables under study

	Male	Female	Sex differences			Younger (11-13)	Older (14-17)	Age differences		
	M(SD)	M(SD)	F(1)	p-value	ηp2	M(SD)	M(SD)	F(1)	p-value	ηp2
Autonomy support	3.09(1.04)	2.99 (1.03)	2.25	.134	<.01	2.96(1.00)	3.08(1.06)	2.81	.094	<.01
Competence support	3.99(0.89)	3.87(0.99)	3.80	.050	.01	3.79(0.93)	4.00(0.95)	9.43	.002	.01
Relatedness support	4.06(0.90)	3.98(0.97)	1.84	.172	<.01	3.94(0.90)	4.60(0.96)	3.72	.050	.01
Novelty support	3.57(1.06)	3.47(1.06)	2.12	.146	<.01	3.39(1.10)	3.59(1.02)	7.36	.007	.01
Autonomy satisfaction	3.14(0.88)	2.92(0.94)	12.15	<.001	.02	2.94(0.90)	3.07(0.93)	3.58	.059	<.01
Competence satisfaction	3.99(0.78)	3.59(0.92)	45.84	<.001	.05	3.71(0.88)	3.82(0.88)	3.23	.073	<.01
Relatedness satisfaction	4.28(0.77)	4.11(0.94)	7.76	.005	.01	4.10(0.94)	4.25(0.82)	6.32	.012	.01
Novelty satisfaction	3.53(0.90)	3.45(0.94)	1.81	.178	<.01	3.38(0.93)	3.55(0.91)	6.99	.008	.01
Autonomous motivation	5.54(1.23)	5.12(1.38)	21.98	<.001	.02	5.13(1.36)	5.42(1.30)	9.95	.002	.01
PA intention	4.35(0.75)	4.02(0.87)	35.34	<.001	.04	4.19(0.82)	4.16(0.85)	0.25	.616	.00