

The importance of novelty satisfaction for multiple positive outcomes in physical education

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Abstract

Novelty has recently been suggested as a candidate basic psychological need within self-determination theory. Taking into account the lack of research on this new construct, the purpose of this study was to show the role of novelty satisfaction in physical education, analyzing its relations with some outcomes that are relevant for academic achievement. Secondary school students ($N = 764$, 383 girls and 381 boys, $M_{\text{age}} = 14.26$ years, $SD = 1.56$) completed measures of basic psychological need satisfaction (autonomy, competence, and relatedness), novelty satisfaction, the three types of intrinsic motivation (to know, to accomplish, and to experience stimulation), and different outcomes (vitality, dispositional flow, and satisfaction) for physical education. Confirmatory factor analysis showed a high correlation between autonomy and novelty satisfaction. The problem of discriminant validity was solved by removing an item from the original version of the Novelty Need Satisfaction Scale due to its overlapping with the autonomy construct. This modification contributed to improving the psychometric properties of this scale. Structural equation modeling showed that satisfaction of the need for competence was the strongest predictor of intrinsic motivation to accomplish and to experience stimulation, whereas novelty satisfaction was the strongest predictor of intrinsic motivation to know. Positive direct and indirect effects from novelty satisfaction to vitality, dispositional flow, and satisfaction with physical education classes were found. These results suggest the importance of teachers developing strategies to provide novelty support with the aim of achieving multiple positive outcomes in physical education.

Keywords

Self-determination theory, motivation, perceived variety, interest, well-being

Introduction

Children, youth, and adults behave actively and attentively when they encounter activities that interest them (Silvia, 2006). Interest is defined as the affect towards activities that provide novelty, challenge, and aesthetic appeal (Deci, 1992); it reflects a positive motivational and emotional state associated with exploration (Kashdan and Silvia, 2009) and is, therefore, essential to achieve optimal results (e.g. cognitive processing, comprehension, standardized test performance, learning, grades, persistence) in the educational setting (Alexander and Grossnickle, 2016). Taking into account that novelty is a central element of interest, comprehensive motivational models should be developed to explain how the novelty perceived by students is related to different educational results and their precursors, in order to create adaptive learning environments (Grossnickle, 2016). In this line, novelty, understood as the need to experience something not previously experienced or which deviates from everyday routine, has recently begun to be studied from the viewpoint of self-determination theory (SDT) (González-Cutre et al., 2016).

SDT (Deci and Ryan, 1991, 2000; Ryan and Deci, 2000, 2017) is currently one of the most popular approaches to the study of motivation and it establishes that everyone has a series of basic psychological needs in the different life areas that should be satisfied in order to develop intrinsic motivation (characterized by enjoyment of the activities carried out) and to achieve personal growth and well-being. This theory proposes three basic psychological needs (autonomy, competence, and relatedness), which have been studied in an extensive range of contexts (Ryan and Deci, 2017), including the educational setting in general (e.g. Reeve, 2012) and physical education in particular (e.g. Van den Berghe et al., 2014). In the classroom (Reeve, 2016), the need for autonomy is satisfied if students can choose some aspects within the teaching-learning process and they feel that their opinions are taken into account. The need for competence is promoted if students perceive that they can successfully

perform the diverse activities that are proposed. Lastly, the need for relatedness is fulfilled when there is good socialization among the classmates, and the students feel at ease with each other, in addition to having a positive interaction with the teacher.

According to González-Cutre et al. (2016), novelty could be an additional candidate need that should be analyzed to examine the functioning of motivational processes in greater depth. After a literature review, these authors argued that novelty seems to be innate, present in all cultures and life stages, and associated with a human being's optimal functioning, thus fulfilling some of the inclusion criteria established by Deci and Ryan (2000). They also showed in two correlational studies that novelty is a different construct from autonomy, competence, and relatedness, and that it was positively associated with life satisfaction and intrinsic motivation in physical education.

Studies drawing on SDT in the field of education (see Ntoumanis, 2012; Núñez and León, 2015, for a review) have attempted, on the one hand, to describe the factors of teaching that are relevant to fulfill the three basic psychological needs and, on the other hand, to determine how satisfaction of these three needs is associated with motivation and various positive consequences. However, the role played by novelty satisfaction in this process is little known because its proposal as a candidate basic psychological need is very recent (González-Cutre et al., 2016). In fact, Study 2 by González-Cutre et al. (2016) is the only study on novelty satisfaction that exists in the educational setting.

Previous studies have used other theoretical frameworks to analyze whether having more or less desire to explore novel, challenging, and uncertain events (curiosity, Kashdan and Silvia, 2009) is related to different adaptive variables in the academic setting, such as conceptual understanding, motivation, persistence, and academic learning (Alexander and Grossnickle, 2016). Nevertheless, the importance of satisfying novelty has not been studied. Other studies have analyzed the role of variety, which is conceptually related to novelty

satisfaction, in a different setting such as that of physical exercise programs (Sylvester et al., 2016a; Sylvester et al., 2014a; Sylvester et al., 2014b; Sylvester et al., 2016b). These studies have shown that perceived variety (psychological experience that includes novel and/or alternating familiar experiences) is positively associated with intrinsic motivation, well-being (positive affect and subjective vitality), and exercising.

The present study was proposed, on the one hand, taking into account the lack of studies on novelty satisfaction in the educational setting and the recent relevance of this variable in the physical activity context. On the other hand, given that the consideration of novelty as a basic psychological need is at an incipient stage, more evidence is needed to settle this issue. In this sense, the aim of this study was to analyze in physical education how novelty satisfaction, together with satisfaction of the three basic psychological needs (autonomy, competence, and relatedness), was associated with different positive outcomes that are relevant for academic achievement: vitality, flow, and satisfaction. In addition, we studied the mediating role of intrinsic motivation in the relationship between need satisfaction and outcomes.

Novelty and intrinsic motivation

The definitions of intrinsic motivation from the SDT perspective (Deci and Ryan, 1991, 2000; Ryan and Deci, 2000) refer to the importance of optimal challenges and novelty but the concrete role played by perceived novelty within intrinsic motivation has not, as yet, been studied. In this study, a tripartite model of intrinsic motivation (Carbonneau et al., 2012) was used to try to delve into this issue. The tripartite model proposes that intrinsic motivation can be divided into intrinsic motivation to know (participating in an activity for the pleasure of learning and understanding), to accomplish (participating in an activity for the pleasure of improving and mastering the performance of a task), and to experience stimulation (participating in an activity for the feelings of excitement, sensory and aesthetic pleasure).

According to these definitions, it is likely that some basic psychological needs have a higher relationship with some components of intrinsic motivation than with others. However, to our knowledge, there is only one study (Banack et al., 2011) that analyzed these relations and it did not contemplate novelty satisfaction as a variable. This study, with Paralympic athletes, showed that perceived competence was the variable that predicted the three types of intrinsic motivation to a greater extent, followed by autonomy. Nevertheless, autonomy satisfaction did not predict intrinsic motivation to know, and relatedness satisfaction did not predict any type of intrinsic motivation.

The integration of novelty into SDT could provide a clearer map of the relations established between the psychological needs and the types of intrinsic motivation. According to the emotional and sensory characteristics that González-Cutre et al. (2016) attribute to the concept of novelty, it could be more closely associated with intrinsic motivation to experience stimulation. For example, the performance of a novel physical activity in a natural environment (e.g. canyoning) could cause arousal because of doing something new in a new environment. The new contextual stimulus would trigger an emotional reaction linked to satisfaction of novelty that would be associated with intrinsic motivation to experience stimulation. However, satisfaction of the need for competence could be more strongly associated with intrinsic motivation to know and to accomplish because it is essential to experience efficacy when intrinsically seeking conceptual and motor learning (Deci and Ryan, 2000). In any case, these are only theoretical hypotheses that should be analyzed to clarify the process of mediation of intrinsic motivation between basic psychological needs satisfaction and outcomes.

Novelty, vitality, flow, and satisfaction in physical education

Regarding the outcomes analyzed in the present study, vitality, flow, and satisfaction were chosen because they represent important variables for academic achievement, which, a

priori, should be related to novelty satisfaction. Vitality is a positive sense of energy and vigor, which has been positively associated with students' autonomous functioning and effort and negatively with depressive feelings (Mouratidis et al., 2017) and it represents one of the dimensions of well-being (Ryan et al., 2008). Well-being in general and vitality in particular have been some of the most studied outcomes in the physical education setting from the SDT viewpoint (e.g. Mouratidis and Lens, 2015; Mouratidis et al., 2011; Taylor and Lonsdale, 2010; Vlachopoulos et al., 2011). These studies show that satisfaction of the three basic psychological needs (autonomy, competence, and relatedness) and intrinsic motivation seem to be essential variables for the promotion of vitality in physical education classes.

Considering that novelty has traditionally been described as an important component of intrinsic motivation, and that intrinsic motivation plays a critical role in people's vitality (Ryan and Deci, 2017), we could expect novelty satisfaction to be associated with vitality.

Flow is an optimal psychological state characterized by a sense of control, total concentration, interest, and pleasure in the activity (Csikszentmihalyi, 1990). These characteristics have been linked to students' meaningful learning, depth of cognitive learning, engagement, creativity, and academic performance (Shernoff et al., 2014). One of the fundamental preconditions of flow is the challenge-skill balance, which, from the SDT perspective, may be considered as a composite of the perceived difficulty and the perceived novelty of the activity (Kawabata and Mallet, 2016). The scarce research on flow in physical education has shown that the frequency with which flow is experienced (dispositional flow) is positively associated with satisfaction of the needs for competence and relatedness and intrinsic motivation (González-Cutre et al., 2009; Stormoen et al., 2016). In view of the importance of novelty to achieve the challenge-skill balance, it is possible that novelty satisfaction may also predict dispositional flow.

Finally, satisfaction with physical education classes has received little research from the SDT viewpoint under a multidimensional conceptualization that takes into account the different facets of teaching (e.g. promotion of theoretical and practical learning, health, and enjoyment). Greater satisfaction is related to more time spent on an activity, commitment, and intention to continue (Cunningham, 2007). Ferriz et al. (2013) found that satisfaction of the three basic psychological needs and intrinsic motivation positively predicted satisfaction with physical education. It seems coherent to consider that the perception of new elements in class can also contribute to students' overall satisfaction with the learned content, the teacher's involvement, and the enjoyment experienced. In fact, teachers play a critical role to guide the students in new aspects, cultivating their natural curiosity to achieve more satisfactory learning (Ostroff, 2016).

The present study was proposed considering the lack of research about novelty satisfaction in physical education from a SDT perspective. This explanatory study analyzed the relations among satisfaction of the three basic psychological needs, novelty satisfaction, different types of intrinsic motivation, and outcomes such as vitality, flow, and satisfaction with physical education classes. We expected to find that satisfaction of the three basic psychological needs and of novelty would predict vitality, dispositional flow, and satisfaction with physical education both directly and mediated through the different types of intrinsic motivation. The inclusion of novelty in the SDT postulates would allow us to better understand how these motivational relations in physical education are produced in order to design interventions aimed at improving academic learning and promoting participation in physical activity after school.

Method

Participants

In this study, participants were 764 students (383 boys and 381 girls), aged between 12 and 20 years ($M = 14.26$, $SD = 1.56$), from three coeducational schools in a Spanish province. Concerning educational level, 175 students were in 1st grade of Compulsory Secondary Education, 150 were in 2nd grade, 171 were in 3rd grade, 142 were 4th-graders, and 126 were in 1st grade of Post-Compulsory Secondary Education. Concerning origin, 92.7% of the students were Caucasian, 3.3% were South American, 2.7% were Arabian, 0.8% were African, and 0.5% were Asian. Concerning the self-reported socio-economic level (i.e. education level and family incomes), 3.3% of the sample reported having a low level, 89.9% of the students reported a medium level, and 6.8% a high level.

Measures

Basic psychological needs. To measure satisfaction of the autonomy, competence, and relatedness needs, we used the Spanish version adapted to physical education (Moreno et al., 2008) of the Basic Psychological Needs in Exercise Scale (BPNES, Vlachopoulos and Michailidou, 2006). Starting with the stem statement “In my physical education classes...”, the instrument is made up of 12 items, four for autonomy (e.g. “The exercises I do are highly compatible with my choices and interests”), four for competence (e.g. “I can perform the exercises effectively”), and four for relatedness (e.g. “I feel very comfortable with my classmates”). Responses are rated on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Novelty. The six items (e.g. “I frequently feel there are novelties for me”) from the Novelty Need Satisfaction Scale (NNSS, González-Cutre et al., 2016) were interspersed with the items of the BPNES and, therefore, rated on 5-point Likert-type scales, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Intrinsic motivation. To measure the different types of intrinsic motivation, we used the Spanish version (Núñez et al., 2006) of the Sport Motivation Scale (Pelletier et al., 1995). It

starts with the question “Why do you participate in physical education classes?”, and, with four items for each variable, the scale measures intrinsic motivation to know (e.g. “For the pleasure that I feel while learning techniques that I have never tried before”), intrinsic motivation to accomplish (e.g. “For the satisfaction I experience while I am perfecting my abilities”), and intrinsic motivation to experience stimulation (e.g. “For the pleasure I feel in living exciting experiences”). The responses were rated on a 7-point Likert scale ranging from 1 (*does not correspond at all*) to 7 (*corresponds exactly*).

Vitality. To measure vitality in physical education classes, we used the Spanish version (Castillo et al., 2017) of the Subjective Vitality Scale (SVS; Bostic et al., 2000; Ryan and Frederick, 1997). This instrument, starting with the stem phrase “In my physical education classes...”, consists of six items (e.g. “I look forward to each new day”, “I feel energized”) that are rated on a 7-point Likert scale ranging from 1 (*not at all true*) to 7 (*very true*).

Flow. To measure dispositional flow in physical education classes, we used the version in Spanish (González-Cutre et al., 2009) of the Dispositional Flow Scale-2 (DFS-2; Jackson and Eklund, 2002). This instrument measures the frequency of flow experiences and contemplates its nine dimensions through a global indicator. Beginning with the stem sentence “In my physical education classes...”, the scale is made up of 36 items (e.g. “The challenge and my skills are at an equally high level”, “I have total concentration”, “I am not worried about what others may be thinking of me”, “The way time passes seems to be different from normal”) that are rated on a 5-point Likert scale ranging from 1 (*never*) to 5 (*always*).

Satisfaction. To measure satisfaction with physical education classes, we used the Spanish version (Sicilia et al., 2014) of the Physical Activity Class Satisfaction Questionnaire (PACSQ, Cunningham, 2007). Participants rated their level of satisfaction with various aspects of their physical education classes: mastery experiences (e.g. “How much I learn

about how to perform better in physical activity or sport"), cognitive development (e.g. "The extent to which I learn the essential concepts of physical education"), teaching (e.g. "The teacher's enthusiasm during the classes"), normative success (e.g. "How I am able to perform better than other students in the class"), interaction with others (e.g. "The overall social atmosphere of the classes"), fun and enjoyment (e.g. "How much fun I have in the class"), improvement of health and fitness (e.g. "The development of greater fitness as a result of these classes"), diversionary experiences (e.g. "The physical exertion during the classes"), and relaxation (e.g. "The way that the physical education classes help me to unwind"). The Spanish version of the PACSQ consists of a total of 33 items that are rated on an 8-point Likert scale ranging from 1 (*no satisfaction*) to 8 (*very satisfying*). In this study, we used a general indicator of the level of satisfaction by calculating the mean score of all the items.

Procedure

The study was approved by the Ethics Committee of the university to which the first author belongs. We requested the informed consent of the families of the minors and of the adult participants in the study. The students were informed that a study would be performed about their motivation in physical education classes, that their responses were anonymous, and that it was very important to respond sincerely. Data collection was carried out for 35 minutes in each class under the supervision of one of the members of the research group, who resolved a few issues about how to fill in the instrument. Data were collected for one month. Bearing in mind that the maximum number of parameters in the hypothesized model was 61, we ensured a number of participants 10 times higher (Kline, 2005).

Data analysis

First, as the NNSS is a recent instrument, and the validation process of a scale should be continuous, we performed confirmatory factor analysis, considering the three basic psychological needs (autonomy, competence, and relatedness) and novelty in the model as

latent correlated variables. Discriminant validity was supported if correlations of the novelty measure with the basic psychological needs measures were different from unity (1.00) by a value 1.96 times the standard error of the correlation (Bagozzi and Kimmel, 1995). Composite reliability (ρ) and Average Variance Extracted (AVE) of novelty were also calculated. Composite reliability higher than .60 (Bagozzi and Yi, 1988) and AVE higher than .50 (Hair et al., 2009) are considered acceptable.

Second, we performed two path analyses to confirm the hypothesized predictive relations between the variables. In the first path analysis, only the three basic psychological needs were included at the first level of prediction, whereas in the second path analysis, we also included novelty. This stepwise analysis was conducted to examine the contribution of novelty satisfaction, compared with the previous theoretical model established by SDT, analyzing whether the relations between variables, as well as the calculated coefficients, were modified. The analyses were conducted with the statistical package IBM® SPSS® AMOS 22, using the covariance matrix and the bootstrapping method. In the analysis, on the one hand, the errors of the three types of intrinsic motivation were correlated and, on the other hand, the errors of the different outcomes.

To analyze the predictive effects of the variables, the direct and indirect effects were taken into account (β weights). In addition, given that these coefficients are affected by variance shared by independent correlated variables, and that their isolated use can lead to misinterpretation of the results (Nathans et al., 2012; Yeatts et al., 2017), we also calculated the product measure (Pratt coefficient), the structure coefficient (r_s), and the squared structure coefficient (r_s^2). The use of multiple statistics may help to determine more precisely the importance of an independent variable in the prediction of a dependent variable.

The product measure is calculated by multiplying the variable's zero-order correlation by its β weight. This coefficient is used to divide the regression effect, so that the sum of the

product measures of each variable is equal to the R^2 of the dependent variable. Therefore, it allows the estimation of a variable's importance from this division of the regression effect. The structure coefficient is computed by dividing the bivariate correlation between the independent and the dependent variables by the multiple correlation (R) for the regression containing all independent variables. The squared structure coefficient indicates the amount of variance of a dependent variable that an independent variable can explain by itself. This measure can also identify whether the contribution of a variable to the regression equation has been minimized in the calculation of its β weight due to assignment to another β weight of the variance it shares with another independent variable (Nathans et al., 2012).

To analyze the goodness of fit of the models, we used the following indices: the comparative fit index (CFI), the incremental fit index (IFI), the root mean square error of approximation (RMSEA) and its 90% confidence interval (CI), and the standardized root mean square residual (SRMR). According to Hu and Bentler (1999), the following cut-points were established as indicative of good fit: CFI and IFI values equal to or higher than .95, RMSEA values equal to or lower than .06, and SRMR values equal to or lower than .08. However, there is a general consensus to consider values over .90 as acceptable for CFI and IFI, in view of the difficulty of obtaining a good fit when analyzing models with multiple variables and using real data instead of simulated data (Marsh et al., 2004). To test the mediation effects, we used the multiple mediation methods of Preacher and Hayes (2008), obtaining the confidence limits for the indirect effects from the bootstrapping.

Results

Preliminary analysis

The confirmatory factor analysis of the model of four correlated variables obtained acceptable fit indices: $\chi^2(129, N = 764) = 693.01, p < .001, CFI = .92, IFI = .92, RMSEA = .076, 90\% CI [.070, .081], SRMR = .077$. The latent variable novelty correlated positively

with competence ($\phi = .72$, $SE = .043$), autonomy ($\phi = .92$, $SE = .047$), and relatedness ($\phi = .46$, $SE = .033$). The results reflected a problem of discriminant validity between novelty and autonomy need satisfaction. This problem was solved by removing the item "I have the opportunity to innovate" from the original version of the NNSS due to its overlapping with the construct of autonomy. The use of the word "opportunity" in the drafting of this item was preventing a clear distinction between the meaning of novelty and autonomy need satisfaction. With this modification of the scale, the fit indices improved, $\chi^2(113, N = 764) = 557.39$, $p < .001$, CFI = .93, IFI = .93, RMSEA = .072, 90% CI [.066, .078], SRMR = .076, and discriminant validity was supported because the factor correlations of novelty satisfaction ($\phi = .71$, $SE = .044$ for competence; $\phi = .90$, $SE = .047$ for autonomy; and $\phi = .47$, $SE = .033$ for relatedness) were less than unity by 1.96 times the standard error of the correlation. Composite reliability ($\rho = .86$) and AVE (.54) values of novelty satisfaction were acceptable.

Main analysis

Table 1 shows the descriptive statistics, Cronbach's alpha coefficient, and the correlations between the variables of the study. Novelty satisfaction correlated positively with the three types of intrinsic motivation and the different outcomes, with very similar correlations to those obtained for the three basic psychological needs.

[Insert Table 1 here]

The two path analyses obtained good fit indices: $\chi^2(4, N = 764) = .70$, $p = .59$, CFI = .99, IFI = .99, RMSEA = .001, 90% CI [.001, .047], SRMR = .007, for the model with the three basic psychological needs; and: $\chi^2(8, N = 764) = 10.48$, $p = .23$, CFI = .99, IFI = .99, RMSEA = .020, 90% CI [.001, .050], SRMR = .011, for the model with three basic psychological needs plus novelty. The direct effects (β weights) and the explained variances (R^2) for both models can be observed in Table 2. Table 3 shows the Pratt coefficients, the structure coefficients (r_s), and the squared structure coefficients (r_s^2). The explained variance

of some variables (i.e. the three types of intrinsic motivation and satisfaction) increased slightly when including novelty in the model, but the main difference lies in the distribution of the effects, especially between novelty, autonomy, and intrinsic motivation to know. The analysis of the different coefficients of the second model with regard to the first one generally showed a decrease in the effect of autonomy and intrinsic motivation to know on the dependent variables, in favor of novelty.

[Insert Table 2 and Table 3 here]

Concretely, the results of the second path analysis reflected that novelty satisfaction predicted intrinsic motivation to know ($\beta = .39, p < .001$), to accomplish ($\beta = .30, p < .001$), and to experience stimulation ($\beta = .24, p < .001$). Autonomy need satisfaction predicted intrinsic motivation to know ($\beta = .11, p < .001$) and to experience stimulation ($\beta = .18, p < .001$). Competence need satisfaction predicted intrinsic motivation to know ($\beta = .33, p < .001$), to accomplish ($\beta = .43, p < .001$), and to experience stimulation ($\beta = .39, p < .001$), whereas relatedness need satisfaction predicted intrinsic motivation to accomplish ($\beta = .08, p < .001$). Intrinsic motivation to know predicted vitality ($\beta = .17, p < .001$) and dispositional flow ($\beta = .09, p = .032$). Intrinsic motivation to accomplish predicted satisfaction with physical education classes ($\beta = .13, p < .001$), whereas intrinsic motivation to experience stimulation predicted vitality ($\beta = .18, p < .001$), dispositional flow ($\beta = .13, p = .003$), and satisfaction ($\beta = .16, p < .001$). Novelty satisfaction predicted vitality (direct effects: $\beta = .10, p = .002$; indirect effects: $\beta = .11, p = .006$), dispositional flow (direct effects: $\beta = .09, p = .017$; indirect effects: $\beta = .07, p = .014$), and satisfaction (direct effects: $\beta = .22, p < .001$; indirect effects: $\beta = .08, p = .006$). Autonomy need satisfaction predicted vitality (direct effects: $\beta = .21, p < .001$; indirect effects: $\beta = .05, p = .008$), dispositional flow (direct effects: $\beta = .09, p = .25$; indirect effects: $\beta = .03, p = .012$), and satisfaction (direct effects: $\beta = .13, p < .001$; indirect effects: $\beta = .03, p = .010$). Competence need satisfaction predicted vitality

(direct effects: $\beta = .30$, $p < .001$; indirect effects: $\beta = .13$, $p = .011$), dispositional flow (direct effects: $\beta = .48$, $p < .001$; indirect effects: $\beta = .08$, $p = .008$), and satisfaction (direct effects: $\beta = .22$, $p < .001$; indirect effects: $\beta = .12$, $p = .006$). Relatedness need satisfaction only predicted satisfaction (direct effects: $\beta = .12$, $p < .001$; indirect effects: $\beta = .01$, $p = .004$). Bootstrap analysis showed that the different estimates were sufficiently robust, with the exception of the standardized regression weight between intrinsic motivation to know and dispositional flow, which showed a high level of fluctuation in the different bootstrapped samples.

Discussion

The purpose of this study was to analyze the role played by novelty satisfaction, together with the three basic psychological needs and intrinsic motivation, in the prediction of vitality, dispositional flow, and satisfaction in physical education classes. The analysis of novelty satisfaction in the educational setting in general, and in physical education in particular, is recent (González-Cutre et al., 2016) and can help us to better understand the teaching-learning process in order to improve it. In addition, the incorporation of novelty in SDT could contribute to refining its postulates to better explain human motivation.

The results of the confirmatory factor analysis of the NNSS initially showed a problem of discriminant validity between the constructs of autonomy and novelty. This problem was solved by eliminating the item "I have the opportunity to innovate" from the original version of the NNSS. Although this problem was not observed in the initial validation study of the scale (González-Cutre et al., 2016), the drafting of the item, in addition to referring to novelty, includes elements of autonomy that affect its content validity. Therefore, we propose reducing the NNSS to five items. Thereby, the psychometric properties of the scale improve, and all the items more clearly reflect perceived novelty. Future studies should continue testing the

validity and reliability of this scale in different life contexts to ensure that the removal of this item improves the measurement of the construct.

Nevertheless, there is a high correlation between perceived novelty and autonomy, which can be explained when considering that novelty satisfaction may occur only when the new stimulus arouses interest, which would be linked to an autonomous process of regulation. Therefore, not all novel stimuli would provoke novelty satisfaction. For each person, the effect of a new stimulus on novelty satisfaction would be different, just as the effect of a challenging stimulus produces greater or lesser perceived competence as a function of individual characteristics (Csikszentmihalyi, 1990). This interaction among basic psychological needs has also become apparent in the case of competence and autonomy (Radel et al., 2013), showing that, in the search for solutions to problems, autonomy only occurs with a high level of perceived competence.

However, although novelty and autonomy are related, it is useful to separate these two concepts from a theoretical viewpoint because, as shown in our model, their relations with other constructs are different. In fact, the results suggest that the inclusion of novelty satisfaction in the model would especially attenuate the relations of perceived autonomy with intrinsic motivation and satisfaction with physical education classes. In addition, from a practical viewpoint, for example, the teacher might propose a novel and surprising activity in physical education classes (e.g. body-combat choreography), which the students have not chosen a priori, but which arouses their interest and produces novelty satisfaction and a series of associated positive consequences. In this case, the teacher would be applying a novelty-supporting strategy clearly differentiated from the strategies used to support autonomy.

The results of the path analysis showed that novelty satisfaction positively and significantly predicted the three types of intrinsic motivation and the three outcomes. The relations of novelty satisfaction with vitality, dispositional flow, and satisfaction with physical

education classes were both direct and mediated by motivation. These results show that novelty behaves according to the SDT postulates. In this sense, perceived novelty would not only directly encourage positive consequences in physical education; it would also do so through increased intrinsic motivation.

With regard to the relations with intrinsic motivation, according to the various statistics calculated (β weights, Pratt, r_s , r_s^2), it should be noted that novelty satisfaction was the variable that best predicted intrinsic motivation to know, followed by competence need satisfaction. However, satisfaction of the need for competence was the variable that best predicted intrinsic motivation to accomplish and intrinsic motivation to experience stimulation, followed by novelty and autonomy need satisfaction. Although it was initially expected that novelty would show a greater association with intrinsic motivation to experience stimulation (Gonzalez-Cutre et al., 2016), it is not surprising that it could play an important role in intrinsic motivation to know. In fact, some authors consider that knowledge is the end goal of curiosity (Reiss, 2004). It seems that the experience of novelty is what the students enjoy the most while they are learning and discovering new aspects in physical education classes, but these new discoveries should be accompanied by the perception of competence to be able to perform them successfully. The perception of competence while performing skills would make them more enjoyable, in addition to being associated with the feeling of stimulation. In this sense, novelty and competence need satisfaction should be in balance to sustain students' intrinsic motivation, in line with the definitions of intrinsic motivation of the founders of SDT (Deci and Ryan, 1991, 2000; Ryan and Deci, 2000). Nevertheless, we should not forget perceived autonomy and relatedness, which the literature has extensively shown to be crucial variables (e.g. Van den Berghe et al., 2014), and which, in this study, have also revealed positive associations with some types of intrinsic motivation. Basically, considering novelty together with autonomy, competence, and relatedness within

SDT could help us to better understand the processes underlying human motivation, increasing their explained variance.

Regarding the prediction of the different outcomes, satisfaction of competence, autonomy, and novelty showed direct and positive effects on all of them, in addition to the indirect effects through intrinsic motivation. However, relatedness satisfaction only predicted satisfaction with the physical education classes according to the β weights. In addition, the remaining statistics (Pratt, r_s , r_s^2) were lower for relatedness than for the other needs. Perceived competence was the most important variable in the explanation of vitality and dispositional flow. Autonomy satisfaction was the second strongest predictor of vitality. The main predictors of satisfaction with physical education classes were competence and novelty satisfaction, with similar strength.

These results reveal, firstly, the relevance of the perception of competence in physical education classes for multiple positive outcomes, in line with prior studies that also analyzed vitality (Taylor and Lonsdale, 2010; Vlachopoulos et al., 2011) and dispositional flow (González-Cutre et al., 2009; Stormoen et al., 2016). However, they also reveal the importance of the other basic psychological needs and novelty satisfaction, and this contributes to the literature on SDT in physical education. The introduction of novel aspects during classes could be associated mainly with students' greater satisfaction, in addition to increased energy, vigor, and frequency of optimal psychological states.

Accordingly, teachers should manipulate the different elements that make up the curriculum, introducing novelty in their speech, content, activities, game rules, materials, technologies, spaces, projects, methodology, and assessment systems. For example, they could introduce activities that are different from the usual ones (e.g. Zumba, Kin-ball) or materials that are not typically used in physical education classes (e.g. Fitball, BOSU, TRX), use some mobile phone applications related to physical activity (e.g. Runtastic), or take the

students outside to carry out physical activities in surprising natural spaces (e.g. canyoning). In fact, a recent qualitative study with teachers and students in physical education classes (Fernandez-Rio and Menendez-Santurio, 2017) has shown that one of the things to highlight in a hybrid Sport Education and Teaching for Personal and Social Responsibility learning unit of kickboxing was the perceived novelty of the content, the teaching approach and the assigned roles. It is likely that the subject of physical education itself can provide more opportunities for novelty than other subjects, given the wide range of existing physical activities, and the possibilities of materials and environments. However, the teacher's knowledge, involvement, and creativity are essential to transform a school with fewer resources, or any subject that a priori has less margin to innovate (e.g. mathematics), into a space for the cultivation of curiosity.

Lastly, we note that intrinsic motivation to experience stimulation was the kind of intrinsic motivation that most strongly predicted the three outcomes, followed by intrinsic motivation to know. It should be noted that the inclusion of novelty satisfaction in the model led to a lower prediction of the consequences by intrinsic motivation to know. This result suggests that introducing novelty into SDT could help to clarify the effects of some variables that have been closely associated with novelty at the conceptual level (e.g. autonomy, intrinsic motivation to know).

In spite of the findings of the present study, which suggest that novelty satisfaction could be important in physical education classes along with the three basic psychological needs postulated in SDT, we must acknowledge the correlational and cross-sectional nature of the study as its main limitation. Although we are in a first phase of the study of novelty satisfaction from the SDT perspective, and it is important to delineate its relations with different variables, future studies should use longitudinal and experimental designs to provide stronger support to these preliminary results. In this sense, it would be interesting to carry out

interventions in physical education classes, developing strategies to provide novelty support and analyze the effect on different variables. It is important to know the dose of novelty that should be provided to prevent a negative effect on the perception of competence, thereby contributing to developing more positive motivation through perceived variety (Lubans et al., 2017; Sylvester et al., 2016a). Future research should analyze when the effect of novelty satisfaction induced by a stimulus ceases, in order to be able to successfully introduce a new stimulus without affecting perceived competence. In this process, it is essential to control what students know to be able to introduce elements that are really novel. New studies should also analyze whether novelty satisfaction in physical education classes could be associated with better performance and learning, and even with higher levels of physical activity outside of the school setting.

Another limitation that we must acknowledge is that the comparison of the β weights with the structure coefficients showed that some variance was shared by the independent variables, which was affecting the regression equations. However, given the complexity of the model analyzed, it was impossible to perform a commonality analysis (Nathans et al., 2012) to identify the patterns and magnitude of shared and unique variance. It would be interesting for future studies to perform the analysis with fewer variables, trying to determine the variance shared by some variables, for example, by autonomy and novelty. Nonetheless, the data clearly show that there is no suppression effect, as there is no independent variable with a negligible zero-order correlation with the dependent variables and a large and statistically significant β weight (Nathans et al., 2012).

It is also necessary to continue analyzing the psychometric properties of the NNSS in different countries and contexts, and to inquire into the relations existing between novelty and the three basic psychological needs. The incorporation of items measuring novelty frustration could be an interesting step to analyze its relations with maladaptive consequences. Moreover,

regarding the consideration of novelty as a basic psychological need in SDT, it is critical to show that it fulfills the different inclusion criteria established by Ryan and Deci (2017), to prove that it is not just a factor or psychological experience that contributes some positive consequences in certain contexts (e.g. physical activity).

In summary, this study has shown that novelty satisfaction is a significant predictor of the three types of intrinsic motivation, vitality, dispositional flow, and satisfaction with physical education classes. The results suggest, on the one hand, that novelty is a relevant variable to consider in the research of motivation because it complements the positive effect of other variables described in SDT; on the other hand, it seems necessary for physical education teachers to include novel aspects in their classes to contribute to the development of positive cognitive, affective, and behavioral outcomes.

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Table 1. *Descriptive Statistics, Cronbach's Alpha, and Correlations among Variables*

Variables	Range	M	SD	α	1	2	3	4	5	6	7	8	9	10
1. Novelty	1-5	3.23	.92	.85		.75	.58	.46	.66	.58	.59	.65	.56	.66
2. Autonomy	1-5	2.96	.89	.80			.63	.48	.62	.55	.62	.69	.59	.66
3. Competence	1-5	3.58	.85	.77				.49	.62	.64	.64	.72	.72	.67
4. Relatedness	1-5	3.99	.89	.82					.43	.45	.41	.45	.44	.52
5. IM to know	1-7	4.35	1.51	.87						.83	.83	.71	.61	.66
6. IM to accomplish	1-7	4.99	1.45	.88							.83	.66	.59	.65
7. IM to stimulation	1-7	4.44	1.44	.84								.71	.61	.66
8. Vitality	1-7	4.37	1.49	.90									.69	.69
9. Flow	1-5	3.57	.67	.95										.75
10. Satisfaction	1-8	5.53	1.33	.97										

Note. IM: Intrinsic motivation.

All the correlations are statistically significant at $p < .001$.

Table 2. Direct Effects (β Weights) and Squared Multiple Correlations among Variables in the Path Analyses

Variables	IM to know ($R^2 = .48/.53$)	IM to accomplish ($R^2 = .45/.48$)	IM to stimulation ($R^2 = .48/.50$)	Vitality ($R^2 = .68/.68$)	Flow ($R^2 = .58/.58$)	Satisfaction ($R^2 = .61/.63$)
Novelty	-.39***	-.30***	-.24***	-.10**	-.09*	-.22***
Autonomy	.37***/.11***	.22***/-	.35***/.18***	.26***/.21***	.12***/.09*	.23***/.13***
Competence	.37***/.33***	.45***/.43***	.42***/.39***	.31***/.30***	.47***/.48***	.23***/.22***
Relatedness	.05*/-	.10***/.08***	-/-	-/-	.06*/-	.15***/.12***
IM to know				.21***/.17***	.13**/.09*	.12*/-
IM to accomplish				-/-	-/-	.11**/.13***
IM to stimulation				.17***/.18***	.11*/.13**	.13**/.16***

Note. The first values presented in each column correspond to the model that does not include novelty satisfaction. IM: Intrinsic motivation.

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 3. *Other Statistics Determining Independent Variables' Contributions to Regression Effects*

Variables	IM to know			IM to accomplish			IM to stimulation			Vitality			Flow			Satisfaction		
	Pratt	r_s	r_s^2	Pratt	r_s	r_s^2	Pratt	r_s	r_s^2	Pratt	r_s	r_s^2	Pratt	r_s	r_s^2	Pratt	r_s	r_s^2
Novelty	-.24	-.91	-.82	-.15	-.83	-.70	-.12	-.83	-.69	-.07	-.79	-.62	-.04	-.73	-.54	-.13	-.83	-.69
Autonomy	.22/.09	.90/.85	.80/.72	.12/.03	.81/.79	.66/.63	.21/.14	.89/.87	.79/.76	.18/.14	.84/.84	.70/.70	.07/.05	.78/.77	.60/.60	.15/.08	.84/.83	.71/.69
Competence	.22/.19	.90/.85	.80/.72	.28/.26	.95/.92	.90/.85	.26/.24	.92/.90	.84/.81	.22/.22	.88/.87	.77/.76	.34/.33	.95/.94	.90/.89	.15/.15	.85/.84	.73/.71
Relatedness	.03/.02	.62/.59	.39/.35	.06/.05	.67/.65	.44/.42	.02/.01	.59/.58	.35/.33	.01/.01	.55/.55	.30/.30	.03/.02	.58/.58	.33/.33	.08/.07	.66/.65	.44/.43
IM to know										.16/.13	.86/.86	.75/.74	.08/.06	.80/.80	.64/.64	.08/.03	.84/.83	.71/.69
IM to accomplish										-.01/-.01	.80/.80	.64/.64	.01/.01	.78/.77	.60/.60	.08/.07	.83/.82	.68/.67
IM to stimulation										.13/.13	.86/.86	.75/.74	.07/.07	.80/.80	.64/.64	.08/.09	.84/.83	.71/.69

Note. The first values presented in each column correspond to the model that does not include novelty satisfaction. r_s : Structure coefficient; IM:

Intrinsic motivation.