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A Multidimensional approach to perceived teachers' autonomy support and its relationship with intrinsic motivation of students in physical education

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This study examined the effects of perceived cognitive, procedural, and organisational autonomy support from teachers on students' intrinsic motivation in physical education (PE). According to self-determination theory, it was expected that psychological need satisfaction for autonomy, competence, and relatedness mediate these effects. It was also expected that the need satisfaction for novelty function as a mediator between dimensions of perceived autonomy support and intrinsic motivation. A total of 705 students (males = 321; Mage = 13.65) completed self-report measures assessing the variables of interest. Structural equation modelling analysis revealed that perceived cognitive autonomy support from teachers was indirectly related to students' intrinsic motivation via the need satisfaction for competence and autonomy. Perceived organisational autonomy support was indirectly related to intrinsic motivation only via the need satisfaction for autonomy, whereas perceived procedural autonomy support was indirectly related to intrinsic motivation only via the need satisfaction for novelty. Results suggest that perceived cognitive, organisational, and procedural autonomy support from teachers are essential antecedents to students' intrinsic motivation in PE.

KEY WORDS: Self-determination theory, psychological need satisfaction, novelty need satisfaction, cognitive autonomy support, procedural autonomy support, organisational autonomy support, motivation.

Being intrinsically motivated towards particular activity refers to individuals participating in it purely for the inherent interest (Deci & Ryan, 2000). A plethora of studies conducted in various contexts, including physical education (PE), have demonstrated intrinsic motivation to be associated

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with a number of adaptive outcomes. For example, intrinsic motivation towards PE has found to be related with higher concentration, preference to attempt challenging tasks, positive affect, and greater effort in classes (e.g., Ntoumanis, 2001; Standage, Duda, & Ntoumanis, 2005; Taylor, Ntoumanis, Standage, & Spray, 2010). In addition, there are consistent evidence that being intrinsically motivated towards PE is associated with higher motivation and intention to be physically active outside of school, as well as leisure-time physical activity behaviour (e.g., Hagger & Chatzisarantis, 2012, 2016; Sproule, Wang, Morgan, McNeill, & McMorris, 2007; Standage, Duda, & Ntoumanis, 2003; Taylor et al., 2010). These advantageous related to intrinsic motivation have led researchers to address social-contextual antecedents of intrinsic motivation.

In a PE context, research has shown that perceived autonomy-supportive teaching style adopted by teachers has a positive effect on students' intrinsic motivation (Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003; Pihu, Hein, Koka, & Hagger, 2008; Standage et al., 2005). While the majority of studies on perceived autonomy support in educational settings, including PE, have treated it as unidimensional construct, Stefanou, Perencevich, DiCintio, and Turner (2004) have proposed that in a classroom the autonomy-supportive behaviours from teachers can be manifested in at least three ways: cognitive, procedural, and organisational autonomy support. Recently, a valid and reliable self-report instrument was developed to assess students' perceptions of teachers' autonomy-supportive behaviours in respect of these three ways, in other words, dimensions, in a context of PE (Tilga, Hein, & Koka, 2017). There is no research to date, however, examining the role of students' perceptions of each of the dimension of autonomy support as potential antecedent of students' intrinsic motivation. The current study, therefore, aimed to contribute to the extant literature (i) by examining the relationship between each of the dimension of perceived teachers' autonomy-supportive behaviour and students' intrinsic motivation in PE and (ii) by addressing the mechanism accounting for these relationships. In doing so, we relied on self-determination theory (SDT; Ryan & Deci, 2000, 2017).

According to SDT, individuals' intrinsic motivation towards a particular activity will be nurtured if they perceive themselves to be effective in the environment (i.e., the need for competence) and feel that their behaviour in that activity is self-endorsed (i.e., the need for autonomy) (Deci & Ryan, 2000). Although there are intrinsically motivated activities (e.g., jogging) that can be pursued in a solitary way, which is why the sense of belonging (i.e., the need for relatedness) might not be always necessary, it has been suggested that the need satisfaction for relatedness may still play a role in conducing occurrence of intrinsic motivation (Ryan & Deci, 2000). For instance, need

satisfaction for relatedness may be important for intrinsic motivation particularly in activities that have a social and interactive element. Although there is some disparity in the relative strength of the three needs satisfaction variables in predicting intrinsic motivation in PE, research has shown that students are more likely to be intrinsically motivated if they feel that their needs for autonomy, competence, and relatedness are satisfied (Goudas, Biddle, & Fox, 1994; Ntoumanis 2001; Standage et al. 2003; Xiang, Agbuga, Liu, & McBride, 2017). A recent review and meta-analysis of Vasconcellos et al. (2019) supported the key tenet of SDT within the school PE context. It was demonstrated that psychological needs satisfaction for autonomy, competence, and relatedness were strongly correlated with students' autonomous motivation consisting of a combined score of intrinsic motivation, integrated, and identified regulation. It is noteworthy that among the needs satisfaction constructs, competence need satisfaction was the strongest predictor of autonomous motivation, followed by the autonomy need satisfaction, while the relatedness need satisfaction being the weakest predictor.

Recently, González-Cutre, Sicilia, Sierra, Ferriz, and Hagger (2016) proposed the need for novelty to be as a candidate basic psychological need. The need for novelty is defined as «the need to experience something not previously experienced or deviates from everyday routine» (González-Cutre et al., 2016, pp. 159). It has been argued that seeking for new experiences is an inherent need that is evident in all stages of individual's development and in all cultures (e.g., Reio & Choi, 2004). Early studies on intrinsic motivation make clear reference to novelty as an important component of intrinsic motivation (Deci & Ryan, 2000; Ryan & Deci, 2000). For example, Ryan and Deci (2000) have stated that intrinsic motivation is «the inherent tendency to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and to learn» (p. 70). Based on the literature review on the importance of novelty to human motivation, as well as drawing from the principles of SDT, González-Cutre et al. (2016) developed and validated an instrument to measure individuals' perceived satisfaction of the need for novelty. The perceived satisfaction of the need for novelty has shown to predict individuals' life satisfaction in a global level (González-Cutre et al., 2016), and autonomous motivation and vitality in a context of physical exercise (González-Cutre, Romero-Elías, Jiménez-Loaisa, Beltrán-Carrillo, & Hagger, 2020). In addition, novelty need satisfaction has shown to predict students' intrinsic/autonomous motivation, vitality, and dispositional flow in, as well as, satisfaction with, PE classes independent of the other three psychological needs satisfaction (Fernández-Espínola, Almagro, Tamayo-Fajardo, & Sáenz-López, 2020; Fierro-Suero, Almagro, Sáenz-López, & Carmona-Márquez, 2020; González-Cutre et al., 2016; González-Cutre & Sicilia,

2019). Considering the advantageous related to the satisfaction of need for novelty in predicting intrinsic motivation, in this study we considered the novelty need satisfaction as an antecedent of students' intrinsic motivation in PE alongside with other three psychological needs satisfaction variables.

A central proposition of SDT is that social-contextual factors that support psychological needs satisfaction would promote the development of individuals' intrinsic motivation (Deci & Ryan, 2000). One strategy which has shown to be effective in fostering students' psychological needs satisfaction and thereby intrinsic motivation is through providing autonomy support from the teacher (e.g., Reeve, Bolt, & Cai, 1999). Autonomy-supportive behaviours include providing choice, giving a rationale for the tasks, and acknowledging students' feelings, while minimizing the use of pressure to control the behaviour (Reeve & Jang, 2006). Studies in PE have found strong evidence of perceived autonomy support from teachers contributing to students' intrinsic motivation (e.g., Hagger et al., 2003; Standage et al., 2005), and that psychological needs satisfaction mediated the relations from perceived autonomy support to intrinsic motivation (Standage et al., 2003, 2005). The recent research in PE has also shown that the more students perceived their teachers to exhibit autonomy-supportive behaviours in classes, the more they felt that their need for novelty was satisfied (Sevil-Serrano, Aibar, Abós, Generelo, & García-González, 2020). It should be noted that in these studies the perceived autonomy support from the teacher was treated as a generalized or, in other words, unidimensional construct. In addition, the measures of perceived autonomy support used in these studies focused exclusively on autonomy support that can be characterized as cognitive autonomy support and discarded other two dimensions, namely organisational and procedural autonomy support, as has been proposed by Stefanou et al. (2004).

The theoretical proposition by Stefanou and colleagues (2004) for multiple dimensions of autonomy support was based on existing autonomy support literature (e.g., Deci, Vallerand, Pelletier, & Ryan, 1991; Reeve et al., 1999; Skinner & Belmont, 1993), as well as the results of their own observational data. As a result, they concluded that classroom teachers displayed supportive behaviours having qualitatively different characteristics and labelled them as organisational, procedural, and cognitive autonomy support. Stefanou et al. (2004) defined the organisational autonomy support from teachers as following: «Organisational autonomy support encourages student ownership of environment and can include teacher behaviours that offer students opportunities for choice over environmental procedures, such as developing rules together, or latitude over rate of progress toward a goal, such as selecting due dates for assignments» (p. 101). In terms of the proce-

dural autonomy support from teachers they defined that «Procedural autonomy support encourages student ownership of form and can include teacher behaviours such as offering students choice of media to present ideas–for instance, making a graph or picture to illustrate a science concept» (p. 101). Finally, «Cognitive autonomy support encourages student ownership of the learning and can include teacher behaviours such as asking students to justify or argue for their point, asking students to generate their own solution paths, or asking students to evaluate their own and others' solutions or ideas» as was defined by Stefanou and colleagues (2004, p. 101).

Based on the work of Stefanou et al. (2004), Tilga and colleagues (2017) lately developed and validated an instrument to assess students' perceptions of their teacher's autonomy-supportive behaviour in these dimensions in a context of school PE. Findings provided empirical evidence that these distinct dimensions of autonomy support from teachers suggested by Stefanou et al. (2004) were also perceived among students in PE. Accordingly, Tilga et al. (2017) proposed that high scores on perceived organisational autonomy support characterize PE teachers who provide students with opportunities to choose between different exercises, places to exercise, and sports equipment. High scores on perceived procedural autonomy support define PE teachers who provide students with opportunities to find out the effect of exercises, guide students in finding their own solutions, and offer hints how to perform better. The perceived cognitive autonomy support describes teachers who convey confidence in students' abilities to do well in lessons, allow students to express their opinions, and make an effort to understand students' needs. Tilga and colleagues (2017) also demonstrated that perceived cognitive autonomy support significantly predicted students' psychological needs satisfaction for autonomy, competence, and relatedness in PE, whereas perceived organisational autonomy support predicted only the need satisfaction for autonomy, and perceived procedural autonomy support predicted only the need satisfaction for relatedness. While it is clear from the existing autonomy supportive literature that perceived teachers' behaviour that can be characterised as cognitive autonomy support is effective in promoting students' intrinsic motivation, to date, there is no empirical evidence as to the contributing effects of perceived procedural and organisational autonomy support on intrinsic motivation.

The Present Study

The aim of this study was to examine the relationships between different dimensions of perceived teachers' autonomy support and students' intrinsic

motivation in PE and to detect the processes (i.e., needs satisfaction) underlying these relationships. The hypothesised model is depicted in Figure 1.

According to the work of Tilga et al. (2017) on multidimensional approach to perceived autonomy support, we hypothesised that perceived cognitive autonomy support would predict all three psychological need satisfaction variables. Perceived procedural autonomy support was expected to predict the need satisfaction for relatedness, whereas perceived organisational autonomy support was supposed to predict the need satisfaction for autonomy (Tilga et al., 2017). In line with theoretical predictions of SDT (Ryan & Deci, 2000) and recent work on perceived autonomy support and novelty need satisfaction in PE (Sevil-Serrano et al., 2020), we expected that perceived cognitive, procedural, and organisational autonomy support would be positively related to the need satisfaction for novelty. The following aspects of different dimensions of perceived autonomy support were expected to be associated with satisfaction of the need for novelty. First, perceived cognitive autonomy support includes behaviours from teachers such as demonstrating interest in what students want to do in classes. This would provide students with opportunities to propose activities by themselves that have not previously done. In other words, the teacher provides students with

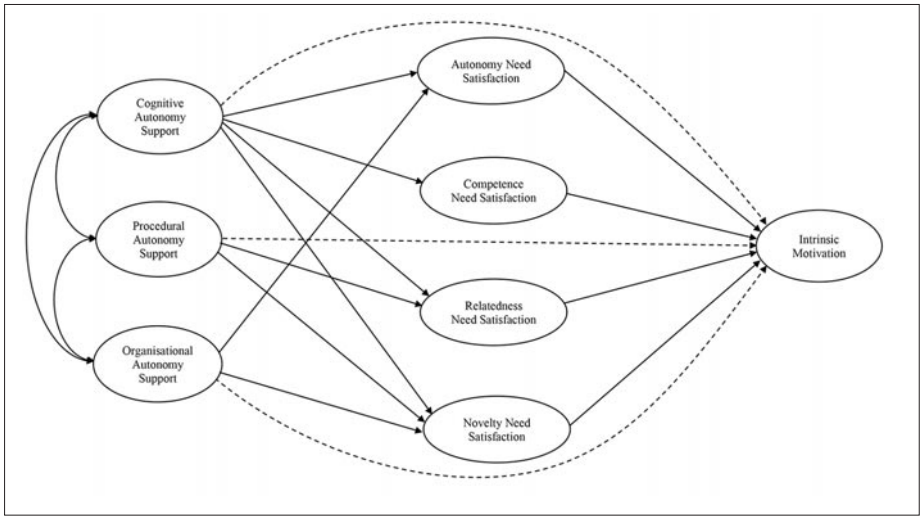

Fig. 1. - The hypothesised structural equation model.
Note. Broken lines indicate paths freed in the test of the hypothesised model but expected to be zero. For clarity, covariances of disturbance terms among the need satisfaction for competence, autonomy, relatedness, and novelty are not displayed.

opportunities to innovate that likely would foster the satisfaction of the need for novelty. Second, perceived procedural autonomy support includes behaviours from teachers such as providing students with opportunities to find their own solutions. This, in turn, would lead students to find out novel solutions that would likely foster the satisfaction of the need for novelty. Third, perceived organisational autonomy support includes behaviours from teachers such as allowing students to choose between different exercises, some of which may be novel to them and may thereby foster the satisfaction of the need for novelty. Consistent with past work conducted in PE (e.g., Fernández-Espínola et al., 2020; Fierro-Suero et al., 2020; Vasconcellos et al., 2019), psychological needs satisfaction variables, including satisfaction of the need for novelty, were hypothesised to predict intrinsic motivation. According to the proposition of SDT and previous studies in PE (e.g., Standage et al., 2003, 2005), we expected that psychological needs will function as mediators of the relationships between distinct dimensions of perceived autonomy support and intrinsic motivation. Specifically, derived from the results of previous work described earlier (González-Cutre et al., 2016; González-Cutre & Sicilia, 2019; Fierro-Suero et al., 2020; Sevil-Serrano et al., 2020; Tilga et al., 2017), we expected that all psychological needs satisfaction variables, including the novelty need satisfaction, will act as mediators of the relationship between perceived cognitive autonomy support and intrinsic motivation. The need satisfaction for relatedness and novelty were hypothesised to function as potential mediators of the relationship between perceived procedural autonomy support and intrinsic motivation, whereas the need satisfaction for autonomy and novelty were supposed to act as mediators of the relationship between perceived organisational autonomy support and intrinsic motivation.

Method

Participants and Procedures

The participants in this study were secondary school students, 6th, 7th, 8th, and 9th graders, from 42 public schools in Estonia. Students were eligible for inclusion if they had no restrictions on their participation in PE classes. A total of 705 students aged between 11 to 16 years (M = 13.65, SD = 1.14; boys = 321; girls = 384) consented to participate in the study. The sample consisted completely of Caucasians. All of the participants were enrolled in a required PE course at the time of this study. They had PE classes two times a week, 45 min per lesson.

Consent to conduct the study was first issued from a local research ethical committee. Then headmasters of 72 public schools were contacted asking permission to carry out the study in their schools. Forty-two consented to participate. After acquiring permission from headmasters who were also asked to act in loco parentis, electronic invitations were spread to

all eligible students via online applications for schools (e.g., e-School or Stuudium[1]). Each invitation included an URL link to an online questionnaire. The participation was voluntary and students completed the questionnaire during the October 2017 at a single time point at their convenience. We used an online survey technique because it is cost-effective and popular among adolescents (Van Selm & Jankowski, 2006).

Measures

When responding to questionnaires participants were instructed to think about their current PE teachers' behaviour and experiences in classes in general and not about in one particular class. Participants responded to all of the items on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Perceptions of Teachers' Autonomy-supportive Behaviour. Students' perceptions of teachers' autonomy-supportive behaviour were assessed using the multidimensional perceived autonomy support scale for physical education (MD-PASS-PE; Tilga et al., 2017). Each item was preceded by the common stem, "My PE teacher …". The MD-PASS-PE consists of 15 items measuring three dimensions of perceived autonomy support: (a) cognitive autonomy support (five items, e.g., "… conveys confidence in my ability to do well in the lesson"); (b) procedural autonomy support (five items, e.g., "… guides students in finding solutions"); and (c) organisational autonomy support (five items, e.g., "… allows me to choose exercise place"). The scale have demonstrated satisfactory factorial structure and internal consistency (Tilga et al., 2017; Trigueros, Aguilar-Parra, Sánchez-Iglesias, González-Bernal, & Mercader, 2020; Burgueño, Macarro-Moreno, & Medina-Casaubón, 2020).

Psychological Need Satisfaction for Autonomy, Competence, and Relatedness. Students' perceptions of autonomy, competence, and relatedness need satisfaction were measured using respective subscales of the basic psychological need satisfaction and need frustration scale (BPNSNF; Chen et al., 2015), adapted for PE by Haerens, Aelterman, Vansteenkiste, Soenens, & Van Petegem (2015). Each item was preceded by the stem, "During the PE lesson…". Each subscale consisted of four items: autonomy (e.g., " … I felt a sense of choice and freedom in the things I undertake"); competence (e.g., "… I felt confident that I could do the exercises well"); and relatedness (e.g., "…I felt that the class members I care about also cared about me"). Each subscale has previously demonstrated satisfactory factorial structure and internal consistency in a context of PE (Haerens et al., 2015; Tilga et al., 2017).

Novelty Need Satisfaction. Students' perceptions of novelty need satisfaction in PE were assessed using the most recent 5-item version of the novelty need satisfaction scale (NNSS; González-Cutre & Sicilia, 2019), initially developed by González-Cutre et al. (2016). An example item included, "I think that new situations come up for me". The scale have demonstrated good factorial validity and reliability (González-Cutre & Sicilia, 2019).

Intrinsic Motivation. Students' intrinsic motivation towards PE were assessed using the four-item intrinsic motivation subscale from the perceived locus of causality (PLOC) scale devised by Goudas et al. (1994). An example item included, "I take part in PE because it is fun". Previous studies employed the PE-adapted PLOC have shown the intrinsic motivation

[1] e-School and Stuudium are online applications for schools in Estonia that connects teachers, parents and students. Study materials, information about academic progress and simple messaging are accessible in one online environment.

subscale to demonstrate high internal reliability (e.g., Goudas et al., 1994; Ntoumanis, 2005; Standage et al., 2005; Viira & Koka, 2012).

Data Analysis

Data were initially screened for outliers. Preliminary analyses using SPSS version 23 involved examining the distribution of the data and internal consistency of scales, as well as the calculation of descriptive statistics. Since the sample of students was nested within 42 schools, we analyzed the amount of variance explained at school level by calculating the intra-class correlations (ICCs) based on the recommendations of Heck, Thomas, & Tabata (2010). The ICC values less than .10 for all study variables would indicate that the multilevel analysis would not be necessary and we could proceed with student-level analysis in the main analysis (Heck et al., 2010; Preacher, Zhang, & Zyphur, 2011).

The main analyses included testing the hypothesized model via structural equation modelling (SEM) using AMOS version 23. According to Anderson and Gerbing (1988), the first step was conducting a confirmatory factor analysis (CFA) to test for the validity of the measurement model with eight latent factors. Once an acceptable measurement model was developed, the next step was testing the hypothesized structural model depicted in Figure 1. Several goodness of fit indices were used to assess the adequacy of CFA and SEM (Hu & Bentler, 1999): the χ^2 test, Comparative Fit Index (CFI), Non-Normed Fit Index (NNFI), and Root Mean Squared Error of Approximation (RMSEA) with its 90% confidence intervals (CI_{90}). According to Hu and Bentler (1999), values close to or greater than .95 for CFI and NNFI, and values .06 or less for RMSEA indicate a good fit of the model to the data. The bootstrap procedure, using 5000 samples, with bias-corrected 95% confidence interval (BC CI_{95}) was employed to test the significance of the indirect effects (i.e., mediated effects) in the hypothesized model (Hayes & Scharkow, 2013). The confidence interval for the indirect effect estimate must not contain a zero to assume a significant indirect effect.

Results

Preliminary Analyses

There were no missing data as the online questionnaire forced responses. Three participants were considered as unengaged respondents and were eliminated from the study as they had given exactly the same response to each item. Based on Mahalanobis distance values, forty-two participants were considered as multivariate outliers and were excluded from further analysis, yielding a final sample of 660 participants (M = 13.63, SD = 1.14; boys = 298; girls = 362). Means, standard deviations, skewness and kurtosis, and internal consistency values for all measurement scales are presented in Table 1. Values of ICCs for all of the study variables ranged from .02 to .09, revealing that relatively little variance (i.e., 2 – 9%) existed at school-level across all variables. Based on these results we considered that the variance at school-level was trivial compared to the variance at student

TABLE I
Descriptive Statistics and Latent Factor Correlations

Variable	M	SD	Skewness	Kurtosis	α	1	2	3	4	5	6	7
1. Cognitive autonomy support	5.11	1.35	–.75	.27	.90	-						
2. Procedural autonomy support	5.14	1.32	–.78	.28	.86	.88	-					
3. Organisational autonomy support	4.22	1.35	–.24	–.41	.88	.87	.86	-				
4. Autonomy need satisfaction	4.40	1.56	–.37	–.53	.93	.84	.79	.82	-			
5. Competence need satisfaction	4.84	1.57	–.68	–.07	.95	.74	.68	.69	.86	-		
6. Relatedness need satisfaction	4.95	1.55	–.68	–.01	.95	.48	.48	.51	.54	.56	-	
7. Novelty need satisfaction	3.90	1.16	–.07	.10	.82	.57	.60	.57	.70	.63	.39	-
8. Intrinsic motivation	4.94	1.80	–.64	–.58	.96	.68	.65	.65	.79	.77	.50	.62

Note. All correlations are significant at $p < .001$.

level and therefore proceeded with student-level analysis in the main analyses.

Main Analyses

The Measurement Model. Although the values for univariate skewness and kurtosis were between -2 and +2 (see Table 1) that have been considered as acceptable to prove normal univariate distribution (George & Mallery, 2010), the Mardia's coefficient value (183.44, critical ratio = 45.05) indicated multivariate non-normality within the data. All the subsequent analyses, therefore, were conducted using bootstrapping procedure as this provides a more accurate estimation of the parameter estimates under the condition of non-normality (Byrne 2010; Preacher & Hayes, 2008).

The measurement CFA model with eight latent factors exhibited a good fit to the data, $\chi^2(566) = 1641.14$, $p < .001$, CFI = .952, NNFI = .946, RMSEA = .054, CI_{90} for RMSEA range = .051–.057.[2] Correlations among latent factors are presented in Table 1. Although correlations among the factors were high and significant, all correlations were significantly different from unity, thus demonstrating discriminant validity between constructs (Bagozzi & Kimmel, 1995).

[2] Prior to the measurement CFA with eight latent factors, we tested multiple item-level CFAs. First, we considered the three basic psychological needs (i.e., autonomy, competence, and relatedness need satisfaction) and novelty need satisfaction in the model as latent correlated variables. Results of the CFA of four correlated factors exhibited good fit to the data: $\chi^2(113) = 474{,}233$, $p < .001$, CFI = .965, NNFI = .958, RMSEA = .070, CI_{90} for RMSEA range = .063–.076. Second, we considered the perceived cognitive, organisational, and procedural autonomy support in the model as latent correlated variables. Results of the CFA of three correlated factors exhibited good fit to the data: $\chi^2(87) = 378{,}328$, $p < .001$, CFI = .957, NNFI = .948, RMSEA = .071, CI_{90} for RMSEA range = .064–.079.

The Hypothesised Model. We first tested the significance of the direct paths from dimensions of perceived autonomy support in the absence of perceived satisfaction of the psychological needs as potential mediators. Results revealed that in the absence of mediators, the direct paths from perceived cognitive autonomy support ($\beta = .39$, $p < .001$) and organisational autonomy support ($\beta = .18$, $p < .05$) were significant. However, the direct path from perceived procedural autonomy support ($\beta = .15$, $p > .05$) to intrinsic motivation did not reach the statistical significance. This model demonstrated good fit to the data, χ^2 (146) = 532.50, $p < .001$, CFI = .964, NNFI = .958, RMSEA = .063, CI_{90} for RMSEA range = .058–.069.

The hypothesised structural model, depicted in Figure 1, with four mediators between perceived autonomy support with dimensions of cognitive, procedural, and organisational autonomy support and students' intrinsic motivation was then tested. The model demonstrated a good fit to the data, χ^2 (570) = 1655.33, $p < .001$, CFI = .951, NNFI = .946, RMSEA = .054, CI_{90} for RMSEA range = .051–.057. Although the model exhibited a good fit, examination of the modification indices (MIs) suggested adding one path, namely organisational autonomy support → relatedness need satisfaction. Statisticians have suggested that model modifications should be included only if there is a theoretical rationale for it (e.g., Byrne 2010). We thus evaluated the additional path on this basis. Including the organisational autonomy support → relatedness need satisfaction path is in line with Stefanou et al. (2004), arguing that organisational autonomy support is characterized as giving students opportunities to choose group members or develop rules together, activities that likely would be linked with students' feelings of relatedness. As a result, this path was added as a free parameter in the model, which exhibited also a good fit to the data, χ^2 (569) = 1648.03, $p < .001$, CFI = .952, NNFI = .946, RMSEA = .054, CI_{90} for RMSEA range = .051–.057. Furthermore, the change in χ^2 was significant between the initial and final hypothesized model, $\Delta\chi^2 = 7.30$, $\Delta df = 1$, $p < .01$, implying that the added path was meaningful.

The standardized path coefficients for free parameters are presented in Figure 2. Results revealed that perceived cognitive autonomy support significantly predicted need satisfaction for competence and autonomy. The perceived organisational autonomy support significantly predicted need satisfaction for autonomy and relatedness, whereas perceived procedural autonomy support predicted only novelty need satisfaction. Satisfaction of the need for autonomy was the strongest predictor of intrinsic motivation followed by satisfaction of the needs for competence and novelty. The direct paths from perceived cognitive and organisational autonomy support to intrinsic motivation were no longer significant. This indicates that relation-

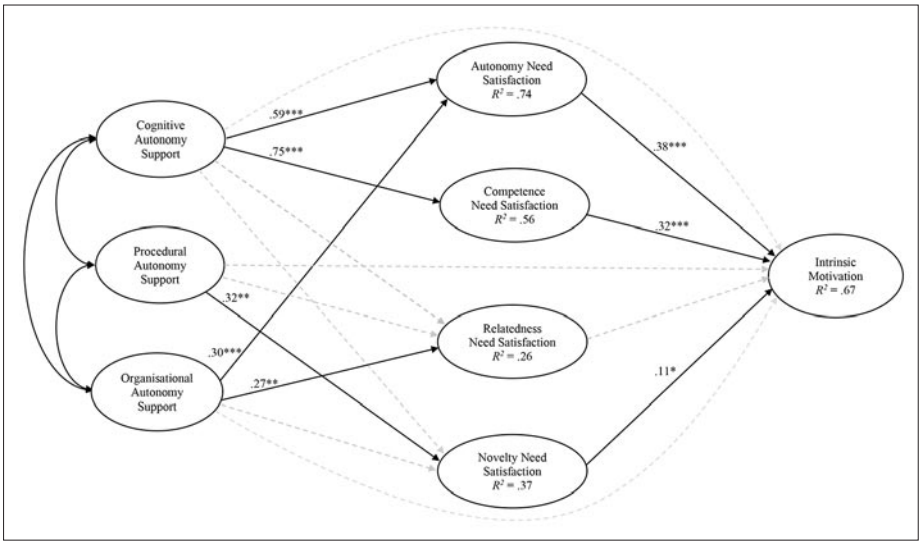

Fig. 2. - Structural equation model showing relations between dimensions of perceived teachers' autonomy support, psychological need satisfaction for autonomy, competence, relatedness, and novelty and intrinsic motivation of students in physical education. Note. The feint broken lines indicate non-significant paths. For clarity, covariances of disturbance terms among the need satisfaction for competence, autonomy, relatedness, and novelty are not displayed. Covariances of the disturbance terms were: $r_{\text{autonomy-competence}} = .65^{***}$, $r_{\text{autonomy-relatedness}} = .22^{***}$, $r_{\text{autonomy-novelty}} = .46^{***}$, $r_{\text{competence-relatedness}} = .32^{***}$, $r_{\text{competence-novelty}} = .35^{***}$, $r_{\text{relatedness-novelty}} = .13^{**}$. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

ships between dimensions of perceived autonomy support and intrinsic motivation were fully mediated by the need satisfaction for autonomy, competence, and novelty. The model accounted for 74%, 56%, 26%, 37%, and 67% of variances in the need satisfaction for autonomy, competence, relatedness, novelty, and intrinsic motivation, respectively.

Specific Indirect Effects. Results revealed that the total indirect effects of cognitive ($\beta = .49$, BC $CI_{95} = .38–.62$, $p < .001$), organisational ($\beta = .14$, BC $CI_{95} = .06–.25$, $p < .001$), and procedural autonomy support ($\beta = .04$, BC $CI_{95} = .01–.10$, $p < .05$) on intrinsic motivation via needs satisfaction variables were significant. In multiple mediator models, however, it is essential to identify the specific role of each mediator in a relationship between independent and dependent variable (MacKinnon, 2000). Table 2 presents the specific indirect effects of dimensions of perceived teachers' autonomy support on students' intrinsic motivation via the need satisfaction for autonomy, com-

TABLE II
Unstandardized (B) and Standardized (β) Specific Indirect Effects of Each Dimension of Perceived Teachers' Autonomy Support on Students' Intrinsic Motivation Through Satisfaction of the Needs for Autonomy, Competence, Relatedness, and Novelty

Independent variable	Mediator variable	Dependent variable	B BC CI_{95} (lower, upper)	β
Cognitive autonomy support	Autonomy need satisfaction	Intrinsic motivation	.33*** (.15, .55)	.22***
	Competence need satisfaction		.35*** (.19, .51)	.24***
	Relatedness need satisfaction		.02 (–.01, .08)	.01
	Novelty need satisfaction		.03 (–.01, .10)	.02
Procedural autonomy support	Relatedness need satisfaction	Intrinsic motivation	.01(–.02, .07)	.01
	Novelty need satisfaction		.07* (.01, .21)	.03*
Organisational autonomy support	Autonomy need satisfaction	Intrinsic motivation	.18*** (.07, .32)	.11***
	Relatedness need satisfaction		.02 (–.01, .08)	.02
	Novelty need satisfaction		.02 (–.01, .09)	.01

Note. BC CI_{95} = Bootstrap-generated bias-corrected 95% confidence interval. *$p < .05$, ***$p < .001$.

petence, relatedness, and novelty. As detailed in Table 2, results revealed that BC CI_{95} for four out of nine indirect effects did not include zero, indicating that these indirect effects were statistically significant. Specifically, the indirect effects of perceived cognitive autonomy support via autonomy and competence need satisfaction were relatively high and similar in size. The indirect effect of perceived organisational autonomy support on intrinsic motivation was evident only via autonomy need satisfaction, whereas the indirect effect of perceived procedural autonomy support only via novelty need satisfaction.

Discussion

This study aimed to examine the relations of perceived cognitive, procedural, and organisational autonomy support from teachers with students' intrinsic motivation in PE, including basic psychological needs satisfaction from SDT and also satisfaction of the need for novelty as potential mediators. The major findings of this study were twofold. First, perceived cognitive and organisational autonomy support from teachers contributed significantly to the prediction of students' intrinsic motivation in PE. Second, satisfaction of the two out of three psychological needs (i.e., autonomy and competence) acted as mediators of the relationships between perceived cognitive and

organisational autonomy support and intrinsic motivation. Specifically, satisfaction of the needs for autonomy and competence accounted for the relationship between perceived cognitive autonomy support and intrinsic motivation, whereas satisfaction of the need for autonomy alone accounted for the relationship between perceived organisational autonomy support and intrinsic motivation. In addition, perceived satisfaction of the need for novelty acted as a mediator of the relationship between perceived procedural autonomy support and intrinsic motivation.

The both perceived cognitive and organisational autonomy support were significantly related to students' intrinsic motivation in PE. In general, this finding is in accordance with SDT (Ryan & Deci, 2000, 2017) and previous studies in PE revealed that the more students perceived their teacher to be autonomy-supportive the more they reported that their reasons to participate in classes were intrinsic (Hagger et al., 2003; Pihu et al., 2008; Standage et al., 2005). The present study, however, demonstrated that compared to perceived cognitive autonomy support, the contribution of perceived organisational autonomy support in predicting intrinsic motivation was weaker. This finding is consistent with the proposition by Stefanou et al. (2004) that activities supporting organisational (or procedural) autonomy may be necessary but insufficient to foster students' intrinsic motivation. Moreover, the latter authors pointed out that autonomy support characterised as cognitive may be the essential component without which intrinsic motivation of students may not be maximized. The finding of the present study extended beyond the previous research by demonstrating that students' perceptions of cognitive autonomy support may be the most influential of all three dimensions of perceived autonomy support in promoting students' intrinsic motivation in PE. This signifies that if the aim is to foster students' intrinsic motivation, teachers should adopt behaviours such as being responsive when students express their opinions and wants; convening confidence in students' abilities to do well in lessons; allowing students to express their opinions; and making an effort to understand students' needs, all behaviours characterised as cognitive autonomy support from PE teachers.

Although perceived cognitive autonomy support emerged as being most strongly related to students' intrinsic motivation, perceived organisational autonomy support was also significantly and positively related to it. This finding is somewhat inconsistent with the notion of Stefanou et al. (2004) arguing that if choices offered are in the area least related to the cognitive aspects of learning, they may direct students' motivation something else than intrinsic. They speculated that in a classroom environment where the teacher supports students' autonomy through practices that offer them choices in an organisational (or procedural) aspects alone, the level of students' self-deter-

mination may remain at something less than in situations in which they are offered opportunities to be originators of actions. Nevertheless, results of the current study indicated that students' perceptions of organisational autonomy support from the teacher may be considered as a meaningful antecedent of students' intrinsic motivation in PE independent of perceived cognitive autonomy support. Teachers, therefore, are advised to adopt behaviours such as allowing students to choose group members and sport equipment; to choose between exercise places and different exercises; and accepting students' different solutions in learning of exercises, all behaviours categorised as organisational autonomy support from PE teachers.

This study showed that psychological needs satisfaction for autonomy and competence, but not relatedness, acted as potential mediators of the relationship between perceived cognitive autonomy support and students' intrinsic motivation in PE. This is because behaviours from teachers such as allowing students to express their opinion, showing interest in what students want to do, and conveying confidence in students' ability to do well in the lesson, all behaviours that can be characterised as cognitive autonomy support, offer opportunities for the need satisfaction for autonomy and competence, which, in turn, promotes intrinsic motivation. These results supported central tenets of SDT (Ryan & Deci, 2000, 2017), in general, that perceptions of social-contextual factors that support individuals' needs satisfaction for autonomy and competence will facilitate the development of intrinsic motivation. In terms of the magnitude of the specific indirect effects, results suggested that indirect effects through needs satisfaction for autonomy and competence, respectively, were relatively comparable in explaining the perceived cognitive autonomy support - intrinsic motivation relation. This finding is consistent with the results of Standage and Gillison (2007). Although the authors used in their study the self-determined motivation index reflecting autonomous motivation, they found that perceived autonomy support positively influenced students' autonomous motivation in PE, equally through the needs satisfaction for autonomy and competence. In all, students' perceptions of cognitive autonomy support from teachers may help foster students' views of themselves as autonomous and competent, and therefore influencing their intrinsic motivation.

This study revealed that students' need satisfaction for autonomy acted as a sole mediator of the relationship between perceived organisational autonomy support and intrinsic motivation. This finding shows that when students perceived that they were provided with opportunities to decide about choosing between different exercises, places to exercise, and sports equipment, all behaviours from teachers that can be characterised as organisational autonomy support, the more they felt that their need for autonomy

was satisfied, which, in turn, contributed to the promotion of intrinsic motivation. This is consistent with the results of Tilga et al. (2017) demonstrating that perceived organisational autonomy support from teachers significantly predicted students' need satisfaction for autonomy in PE. It is noteworthy that MIs suggested adding the path from perceived organisational autonomy support to the need satisfaction for relatedness. We perused the MIs with care and ensured that this change, being the only one made on the basis of MIs, was theoretically viable and justified. Results thus revealed that the more students perceived that their teachers used behaviours categorised as organisational autonomy support, the more they felt their need for relatedness to be satisfied. The need satisfaction for relatedness, however, did not significantly contribute to the development of intrinsic motivation, as has been already stated. An insignificant contribution of the need satisfaction for relatedness on intrinsic motivation is not completely surprising as Xiang et al. (2017) lately also failed to provide evidence that need satisfaction for relatedness contributed to intrinsic motivation among a sample of students in secondary PE. In addition, a study of González-Cutre and Sicilia (2019) have demonstrated that the need satisfaction for relatedness was the least important variable in the explanation of three types of intrinsic motivation (i.e., intrinsic motivation to know, intrinsic motivation to accomplish, and intrinsic motivation to experience stimulation) of students in PE. This may be because there are conditions in which relatedness satisfaction is less central to intrinsic motivation compared to the needs satisfaction for autonomy and competence (Deci & Ryan, 2000). As has been suggested by Leptokaridou et al. (2015), the more distal role of the need satisfaction for relatedness in predicting intrinsic motivation may be explained by the fact that children in PE are often encouraged to master the tasks that are individual in nature and thus do not provide much opportunities to feel connected to others.

With regard to the need satisfaction for novelty, the results indicated that it functioned as a mediator of the relationship between perceived procedural autonomy support and intrinsic motivation. It seems to suggest that if the PE teacher provide students with opportunities to find out the effect of exercises or find their own solutions, a behaviour that can be categorised as procedural autonomy support (Stefanou et al., 2004; Tilga et al., 2017), it may lead students to find out novel solutions. This, in turn, may foster the need satisfaction for novelty and thereby promote higher levels of intrinsic motivation. Although the magnitude of the indirect effect through the need satisfaction for novelty was small, compared to the indirect effects through the needs satisfaction for autonomy and competence, results of the present study provided preliminary evidence on the utility of novelty need satisfaction alongside with other psychological needs satisfaction from SDT as a

means of understanding how perceived procedural autonomy support from teachers may be related to students' intrinsic motivation in PE. Moreover, to the best of our knowledge, the present study is one of the first studies that demonstrated the mediating role of the need satisfaction of novelty of a relationship between perceived autonomy support and intrinsic motivation. This finding supports one of the inclusion criteria, established by Ryan and Deci (2017), that should be met for candidate needs to be included within the basic psychological need theory, i.e., "The postulated basic psychological need must be essential to the interpretation of empirical phenomena, and, therefore, any new need should be a consistent mediator of relations between social and personal factors and individuals' motivational and psychosocial functioning" (González-Cutre et al., 2020, p. 296).

Limitations and Future Directions

Although the results of the present study provided interesting and unique information about the relationships between dimensions of perceived autonomy support from teachers, satisfaction of psychological needs, including the need satisfaction for novelty, and intrinsic motivation among students in secondary school PE, some caution should be exercised when interpreting the results. First, the design the current study adopted was cross-sectional, which precludes us from drawing conclusions about the causality. Therefore, future studies should adopt a longitudinal or experimental study design to test the causal nature of the proposed relationships.

Second, the explanatory mediating mechanism (i.e., mediator variables such as psychological needs satisfaction, including the need satisfaction for novelty) behind the relationship between independent variables (i.e., dimensions of perceived autonomy support) and dependent variable (i.e., intrinsic motivation) were all assessed simultaneously. This may lead to the situation that students' experiences of interest-enjoyment may have influenced students' need-based experiences and not vice versa. Therefore, as has been suggested by Mabbe, Soenens, De Muynck, & Vansteenkiste (2018), future studies would do well by assessing assumed mediators prior to assessing the dependent variable.

Third, the current study was based entirely on students' self-reports. The caution should indeed be exercised when interpreting students' self-reports. It has been argued, however, that students' subjective ratings of their teachers' behaviour are comparatively valid (Scriven, 1988). Nevertheless, researchers (e.g., Haerens et al., 2015) have suggested that in order to obtain a more accurate picture of whether the teacher exhibits various types of behaviour, and to what extent, a multi-informant (teacher, observer, student) perspective should be adopted. Future studies, therefore, would do well

incorporating both teachers' and students' self-reports, as well as ratings of external observers when examining the role of each dimension of autonomy support from the teacher on students' intrinsic motivation.

Fourth, testing the hypothesised model in a PE context alone is also a limitation. Future research, therefore, may consider applying the model in other subjects to extend the generalizability of the model. Fifth, the data were collected from students in one country and participants consisted completely of Caucasians. Future research should, therefore, investigate whether relationships found in this study will hold also in other national and ethnic groups. Sixth, although students were instructed to think about their current PE teacher when responding to questionnaires, the exact range of experience each participant has had with their current PE teacher was unknown to us. Future studies would do well by taking into account the students' range of experiences with their PE teachers when examining students' perceptions of their teachers' behaviour. Finally, it should be noted that the present study was solely based on an online survey that has shown to have response rate limitations (Kraut et al., 2004). This might have been a case also in the present study. It is very likely that not all eligible participants accepted our invitation to participate in the study and completed the online questionnaire. This, again, reduces the degree of generalizability of the results.

Conclusions

The findings of the present study suggest that especially perceived cognitive autonomy support, but also organisational and procedural autonomy support from the teacher, can help to explain why students become more intrinsically motivated towards PE. This study is unique as it provides the preliminary evidence on the mechanism by which each dimension of perceived teachers' autonomy support is related to students' intrinsic motivation in PE. Overall, findings suggest that PE teachers do well interacting with students in a way that is supportive of students' psychological needs satisfaction for autonomy and competence, but also the need satisfaction for novelty.

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