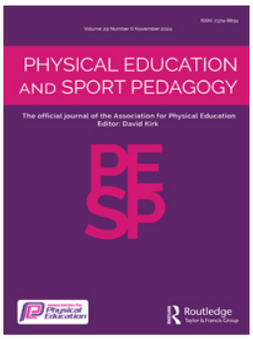

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Are physical education teachers' autonomy-supportive behaviors related to high-school students' actual game-play performance?

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ABSTRACT

Background: Although studies based on self-determination theory have shown a relation between teachers' autonomy-supportive teaching behaviors and students' positive outcomes in physical education (PE), only a few studies have tested the relation between autonomy support and students' actual game-play performance in a PE context.

Purpose: The purpose of this study was to examine whether physical education (PE) teachers' autonomy-supportive behaviors would predict high school students' actual game-play performance in PE activities.

Method: A total of 286 students ($M_{age} = 15.24$, $SD = 3.99$) reported on their perceptions of their teachers' autonomy-supportive behaviors, their experience of need satisfaction, and their autonomous motivation toward learning PE activities questionnaires. Teachers ($N = 7$, female = 3, $M_{age} = 38.57$) and an expert rater measured students' actual game-play performance with a comprehensive behavioral assessment tool.

Results: The results revealed that teachers' autonomy support correlated positively with students' psychological variables of need satisfaction, and autonomous motivation. Need satisfaction and autonomous motivation positively correlated with game performance either measured by teachers or measured by the expert rater. A path analysis showed that autonomy support positively predicted actual game performance measured by the expert rater ($\beta = .05$; $p < .05$) through need satisfaction and autonomous motivation.

Conclusion: The results suggest that PE teachers' autonomy-supportive teaching styles promote not only students' need satisfaction and autonomous motivation in PE activities, but also their actual game-play performance.

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KEYWORDS
Self-determination theory; game performance; need satisfaction; autonomous motivation; physical education

Introduction

According to the National Association for Sport and Physical Education (SHAPE 2014), one of the most important goals of physical education (PE) programs is to help students develop motor skills. Acquiring motor skills is not only important for improving students' performance in sports, but it can also facilitate their engagement with a variety of physical health behaviors (e.g. exercise) and improve their well-being. Moreover, developing motor skills and physical activity at an early age can help set youth on a trajectory of lifelong engagement with physical activity (Jones et al. 2013) – an important contributor to their overall health and wellness. For example, developing

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motor skills can help youth develop a sense of physical competence and enhance their well-being, further encouraging future physical activity and even success in real-world sports (Donnelly, Mueller, and Gallahue 2016).

To investigate motor skill acquisition in PE, researchers have emphasized the importance of assessing the role of teachers' interpersonal behaviors not only on helping students learn new skills, but also on using these skills in actual game-play situations in sports (Behzadnia, Mohammadzadeh, and Ahmadi 2019; Memmert and Harvey 2008; Van den Berghe et al. 2014). However, much of the research in PE has not measured students' actual game-play performance, and instead focused on outcomes such as well-being or intention to continue engaging in physical activity. Of the subset of studies that have examined the relations of teachers' interpersonal behaviors with students' performance (e.g. Cheon, Reeve, and Moon 2012; Haerens et al. 2017), outcome assessments were limited in scope, including the use of self-report measures or course grades as proxies for performance, rather than measuring actual game-play performance with validated assessments by trained expert raters. Simply put, although there is an abundance of empirical evidence through the lens of self-determination theory (SDT; Ryan and Deci 2017) demonstrating that teachers' interpersonal behaviors positively predict students' high-quality motivation for PE and well-being, investigations are needed to examine whether teachers' interpersonal behaviors positively relate to students' actual game-play performance. In the current study, therefore, we take an SDT-based approach to examine the associations between high-school PE teachers' psychological need-supportive behaviors and actual game-play performance of the students.

Self-determination theory

Basic psychological need support and satisfaction

According to SDT, all human beings have three basic and fundamental psychological needs, namely, the needs for autonomy, competence, and relatedness (Deci and Ryan 2000; Ryan and Deci 2000). The need for *autonomy* refers to people's experiences of volition and wholehearted endorsement of their actions (deCharms 1968; Deci and Ryan 1985). The need for *competence* refers to feeling effective in one's interactions with the environment and the desire to extend one's skills (Deci 1975; White 1959). The need for *relatedness* refers to the experience of caring for others, feeling cared for by them, and having a sense of belonging within one's groups or social circles (Baumeister and Leary 1995; Deci and Ryan 2000, 1991). Research has shown that satisfaction of the basic psychological needs fosters a host of positive outcomes, such as autonomous motivation (Haerens et al. 2015), engagement in learning activities, (Cheon, Reeve, and Song 2016), positive functioning (Jang et al. 2009; Standage, Duda, and Ntoumanis 2005), and intentions to continue in physical activities in the future (Hagger et al. 2003; Ntoumanis 2005).

Importantly, people's basic needs are more likely to be satisfied when factors in their social contexts, such as their teachers' interpersonal styles, are supportive of these needs (e.g. Cheon, Reeve, and Ntoumanis 2018; Jang et al. 2009). Experimental research has shown that teachers' autonomy-supportive behaviors such as taking the students' internal frame of reference, encouraging them to take initiative, providing them with options and choices, and offering meaningful rationales when requesting that the students do specific tasks or activities, positively enhance need satisfaction (Cheon, Reeve, and Moon 2012; Cheon, Reeve, and Ntoumanis 2018) autonomous motivation (Cheon and Reeve 2013; Cheon, Reeve, and Moon 2012), and positive outcomes of perceived skill development and future intention to engage in physical activity behaviors (Cheon and Reeve 2013; Cheon, Reeve, and Moon 2012). It is important to note that previous research used the term autonomy support as an instructional way to satisfy the three needs (Reeve and Cheon 2021; Su and Reeve 2011). Although research also shows how other forms of need support for competence (e.g. structure) and relatedness (involved/warm teaching) can foster need satisfaction, we focused on autonomy support in the current study as it has been shown to predict students' higher quality motivation, higher learning and performance, and greater well-being (Reeve 2016).

Autonomous motivation

Within SDT, the concept of motivation is differentiated into types, with the most important distinction being between *autonomous* and *controlled* motivations (Ryan and Deci 2000). Specially, autonomous motivation is a high-quality form of motivation (i.e. comes from within oneself) that is operative when people engage in an activity with a full sense of volition and willingness. Its bases are intrinsic motivation (i.e. doing a task out of interest and enjoyment) and fully internalized extrinsic motivation (i.e. doing a task because the person has accepted the value and meaning of the activity for himself or herself). Controlled motivation, in contrast, is a functionally lower-quality motivation (i.e. comes from outside of oneself) that is operative when people do an activity with a sense of demand, pressure, and coercion. Its bases are externally regulated extrinsic motivation (i.e. motivation pressured by external contingencies) and internally demanded extrinsic motivation (i.e. motivation pressured by internally demanded contingencies such as the avoidance of guilt). The latter type of control results from a partial internalization and is referred to as introjected regulation. Research has shown that high-quality form of motivation relates to skill development and sport performance (Behzadnia et al. 2018; Vansteenkiste et al. 2004), whereas lower-quality motivation relates to ill-being (Ntoumanis 2005) in PE activities.

Abundant research has shown that satisfaction of the three basic psychological needs fosters autonomous motivation, and that autonomous motivation predicts enjoyment and sustained engagement with activities including PE (Ryan and Deci 2017). But why would autonomous motivation be positively associated with actual game-play performance? According to Ryan and Deci (2017), when students are autonomously motivated and wholeheartedly self-endorse the game or sport they are learning and engaged with, they have greater access to their personal resources, capacities, and energies for that learning, thus resulting in greater skill acquisition and game-play performance.

Research connecting autonomy support with performance in PE

Initial research showed that students' autonomous forms of motivation contributed to greater performance (Chow et al. 2021), skill learning (i.e. basic gymnastics exercises like the backward roll and cartwheel) (Boiché et al. 2008) and learning achievement (i.e. cardiovascular fitness and knowledge) (Shen et al. 2009) in middle-school PE. One of the important roles of PE teachers is to help students develop and improve their performance in game play activities (Donnelly, Mueller, and Gallahue 2016). When PE teachers adopt an autonomy-supportive teaching style, it may facilitate students' performance in real game situations (Gil-Arias et al. 2020). In addition, according to the motor learning principle, instructors are important facilitators of students' motor-skill acquisition and performance (Davids, Button, and Bennett 2008; Hodges and Franks 2004; Schmidt and Wrisberg 2008). Instructors can facilitate learners' skill learning and performance by understanding students' specific needs and tailoring their teaching to meet those needs (Schmidt and Lee 2011). In other words, the role of instructors can be seen as environment architects who design innovative tasks and programs to enhance learners' creativity and their capacity to learn and perform (see Newcombe, Davids, and Roberts 2021). This type of instruction and support can be linked directly to autonomy-supportive teaching, which is focused on taking the learner's perspective and helping them take initiative in their skill acquisition. Research has also shown that teachers' autonomy-supportive teaching style is related to students' self-reporting skill development (Cheon, Reeve, and Moon 2012), exercise performance (Vansteenkiste et al. 2004), and PE grades either through students' self-reports (Ulstad et al. 2018; Ulstad, Halvari, and Deci 2018a) or through teachers' reports (e.g. Krijgsman et al. 2017). Although initial research has found a link between an autonomy-supportive teaching style and PE students' performance, there is room for improvement in how performance has been measured. For example, performance has been assessed via PE grades (Ulstad et al. 2018; Ulstad, Halvari, and Deci 2018a) or student's self-reports (e.g. Krijgsman et al. 2017).

Further, the motor skill learning literature has mostly focused on investigating fundamental movement skills (e.g. movement sideways and jumping laterally), rather than examining actual sport performance during game play in PE.

Recently, Behzadnia and colleagues (2018) found support for a link between autonomy-supportive teaching in PE and students' performance. The researchers assessed a sample of 140 Iranian college PE students' game-play performance (using Game Performance Assessment Instrument: GPAI) via expert raters, and found that teachers' autonomy-supportive behaviors positively predicted students' game performance. That was the first study to our knowledge that demonstrated this association with a comprehensive measure of game-play performance in PE; yet research is needed to examine this link within (a) a larger sample of PE students (286 instead of 140), (b) students who were in high school rather than college, and (c) students who were from a different culture (North America rather than Iran).

Present study

In this study, we specifically built upon the work of Behzadnia and colleagues (2018) to examine how high-school teachers' autonomy-supportive behaviors would relate to students' game-play performance in PE classes at the end of a semester-long course. Some motor-learning studies have assessed the relations of autonomy support to students' performance during periods of time as short as two days (Hooyman, Wulf, and Lewthwaite 2014; Wulf, Chiviacowsky, and Cardozo 2014). Importantly, however, having a real experience of autonomy support often takes significant time to develop, so, in the current study, we measured study variables during the last weeks of the school year so there would be sufficient interaction between teachers and students for hypothesized relations to develop (Ryan and Deci 2017). We also aimed to focus on the bright side of motivation to see how it would positively relate to real game-play performance in PE, as to our knowledge this study is the first study to examine the relation between SDT variables and real game-play performance in PE.

In addition, in the current study, we tested an SDT-based model (Ryan and Deci 2017) to examine whether autonomy-supportive teaching would predict PE students' game-play performance, with this relation being mediated by basic psychological need satisfaction and autonomous motivation. Specifically, teachers' autonomy-supportive teaching style may facilitate students' satisfaction of their basic psychological needs and promote their intrinsic motivation to actively engage in activities so that it would result in positive outcomes such as greater performance. Previous research showed that both need satisfaction and autonomous motivation play a mediational role in the relation between teachers' interpersonal behaviors and students' outcomes, such as school PE related skills and fundamental movement skills (de Bruijn and Mombarg 2022) and real game-play performance in college PE (Behzadnia et al. 2018). In the current study we investigated the following two hypotheses:

H1. High school PE students' perceptions of their teachers' autonomy-supportive behaviors would predict positively the students' basic psychological need satisfactions, autonomous motivation, and performance.

H2. Satisfaction of basic needs and autonomous motivation would mediate positively the links from perceived teachers' autonomy-supportive behaviors to student's game-play performance.

Method

Participants and procedures

Participants were two hundred eighty-six students (50% females) in grades 9 through 12 (mean age = 15.24 years, $SD = 3.99$) from a convenience sample at a city high school in New York. The high school was selected because it is a City School with a reasonably diverse population that was available to the researchers. Passive consent was provided by a parent of each of the participating

students, and each participant signed a consent form. The procedure was approved by the Office of Human Subjects Protection.

Students in the high school took PE classes throughout most of the year, generally in three-week blocks with varied activities in the different blocks. For any specific block, a student could choose what sport or activity he or she would focus on for that 3-week period. The PE programs included two 90-minute sessions each week. The current research was conducted during the last block of the spring 2017 semester, and for that period students could choose badminton (28%), basketball (39.2%), or volleyball (32.9%) to engage in during the block. In a later class in the block, students completed questionnaires assessing their autonomous motivation, and need satisfaction, as well as their perceptions of the need support of their PE instructor. Then, in each of the three blocks one of the teachers and the expert observer each rated the students' performance using the Game Performance Assessment Instrument (GPAI). The expert rater holds a PhD in Motor Learning and has several years of experience teaching PE and working with GPAI in activities such as Badminton, Basketball, and Volleyball. There were seven PE teachers (3 females and 4 males) with an average of 38.57 years of age and an average of 13.86 years of teaching experience.

Measures

Perceived teacher autonomy support

Students' perceptions of teachers' autonomy-supportive behaviors were measured through the short five-item version of the Learning Climate Questionnaire (LCQ; Williams and Deci 1996). Students responded to the stem, 'In this PE class … ' The LCQ includes items such as 'I feel my instructor provides me with choices and options.' The responses were anchored on a scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). To test the validity of five-item version of the LCQ, Confirmatory Factor Analysis (CFA) was performed with Mplus. The higher-order of the LCQ with five items fitted the data well, χ^2 (5) = 7.07, p = .22, CFI = 1.00, TLI = 1.00, RMSEA = .038 [90%CI = .00, .098], SRMR = .009. All indicators loadings were above .85, $p < .001$. Items of the LCQ are reported at Appendix. Based on the Standards for Educational and Psychological Testing (American Educational Research Association, et al. 2014), the reasons we selected these five items were based on (a) the content of this PE research, and (b) relations to other variables (i.e. relations to basic psychological need satisfaction, autonomous motivation, and performance, see Table 1) (see also Gunnell et al. 2014). We used the five-item version of the LCQ applicable in context of PE and game performance and recent research has supported the validity of this short form of the scale (Simon and Salanga 2021).

Basic psychological need satisfactions

Satisfactions of the basic psychological needs was measured with the shortened six-item version of the Basic Psychological Needs Satisfaction Scale (BPNSNF; Chen et al. 2015). The short version of the BPNSNF has been previously used in the context of PE (Behzadnia et al. 2018). Students responded to the stem, 'During the PE lesson … ' The BPNSNF measured autonomy need satisfaction (2 items: e.g. 'I felt that the exercises reflect what I really want'), competence need satisfaction (2 items: e.g. 'I felt confident that I could do the exercises well'), and relatedness need satisfaction (2 items: e.g. 'I experienced a warm feeling with the class members I spent time with'). The responses were anchored on a scale ranging from 1 (*not at all true*) to 7 (*very true*). To examine the internal structure of need satisfaction, a higher-order CFA with six items was conducted. This higher-order model fit the data well, χ^2 (4) = 5.08, p = .27, CFI = 1.00, TLI = .99, RMSEA = .031 [90%CI = .00, .10], SRMR = .012. All indicators loadings were above .44, $p < .001$. Behzadnia et al. (2018) used the short 12-item version of the BPNSNF that measures need satisfaction and need frustration (see also Van der Kaap-Deeder et al. 2020, for details about BPNSNF), and based on the goals of the current study to examine the bright side of need fulfillment, we only used the six items that measured need satisfaction. Items of the BPNSNF are reported at Appendix.

Table 1. Descriptive statistics and correlations between variables.

					Sports			Sport Background		Gender							
		M	*SD*	α	Volleyball	Badminton	Basketball	Yes	No	Female	Male	1	2	3	4	5	6
1	Autonomy Support	5.22	1.49	.93	5.10	5.38	4.76	5.30	4.86	5.01	5.16	1					
2	Need Satisfaction	4.75	1.26	.79	4.68	4.52	4.57	4.91	4.27	4.49	4.69	.65***	1				
3	Autonomous Motivation	4.72	1.45	.81	4.91	3.96	4.59	4.82	4.15	4.43	4.54	.44***	.64***	1			
4	Performance 1	5.65	1.78	–	5.80	5.38	5.72	5.88	5.28	5.83	5.48	.10	.16**	.14*	1		
5	Performance 2	4.38	2.27	–	3.64	3.03	5.96	4.79	3.70	3.47	5.29	.09	.18**	.23***	.32***	1	
6	Age	16.20	1.35	–	16.36	16.41	15.91	16.15	16.28	16.22	16.18	.07	.12	.09	.05	−.08	1

Note: Performance 1 = performance measured by teachers. Performance 2 = performance measured by the trained observer. *$p < .05$, ** $p < .01$, *** $p < .001$.

Autonomous motivation

Students' autonomous motivation in PE was measured with the shortened four-item version of the Learning Self-Regulation Questionnaire (SRQ-L; Black and Deci 2000). Students responded to items about the specific sport activity they engaged in. Sample stems for badminton included: 'I participated actively in the badminton exercises' and 'The reason that I worked to expand my knowledge of badminton was … ' Sample item included: 'Because it's interesting to learn more about the nature of badminton.' The responses were anchored on a scale of 1 (*not at all true*) to 7 (*very true*). Behzadnia et al. (2018) modified the SRQ-L to PE activities. CFA with a higher-order of autonomous motivation with four items, yielded a satisfactory fit, χ^2 (2) = 5.68, p = .19, CFI = .99, TLI = .97, RMSEA = .08 [90%CI = .00, .16], SRMR = .019. All indicators loadings were above .55, p < .001. Items of the SRQ-PE are reported at Appendix. The validity of SRQ-L was based on four criteria outlined by the American Educational Research Association et al. (2014): (a) the content of this PE research, (b) internal structure (the results of the CFA), (c) relations to other variables (i.e. relations to autonomy support and basic psychological need satisfaction, see Table 1), and (d) and the positive outcomes associated with testing the shortened SRQ-L (i.e. testing the positive association between autonomous motivation and game performance) (see also Gunnell et al. 2014).

Game performance assessment

Participants' game-play performance was evaluated by the Game Performance Assessment Instrument (GPAI; Oslin, Mitchell, and Griffin 1998) at the end of a PE lesson when students learned specific activities of badminton, basketball, or volleyball. The GPAI is generally used to measure individual components of game performance and overall game involvement. The teachers and one trained observer (expert on PE and coaching) rated students' performance based on time rather than number of trials – that is, the teachers and trained observer rated each students' performance during 20–25 minutes in order to observe their performance criteria (i.e. base, decision-making, and skill execution, as well as skill acquisition) when they were playing the game. More specifically the three components/criteria were: *base* ('appropriate return of the performer to a recovery/base position between skill attempts'), *decision making* ('makes appropriate decisions about what to do with the ball/ projectile during a game'), and *skill execution* ('efficient execution of selected skills'). Participants' game-play performance was assessed using a 10-point scale ranging from 1 (*Very weak performance*) to 10 (*Very effective performance*) by the teachers and observer.

Because it was unclear whether teachers and the trained expert would rate game performance the same, Cohen's Kappa was run to test the agreement between teachers and the trained observer's game performance ratings. There was not strong agreement between teachers and the trained observer on students' game performance (κ = .01, p = .38). Therefore, in the main analyses, we included separate performance outcomes as measured by teachers versus the trained observer (see Plan of Analysis). In addition, we computed an average performance score average mean of three criteria/components of base, skill execution, and decision making (see Behzadnia and colleagues (2018) for a review) for each student, that measured by teachers and by trained observer.

Plan of analysis

In accordance with Allison (2003) and Li, Stuart, and Allison (2015) missing values were screened through multiple imputations. Skewness and kurtosis were examined for the univariate distributions of the study variables. The variables normally distributed in a range from −.16 to .45. Internal consistency of scales was computed through Cronbach's alpha coefficients (Cronbach 1951). Also, three MANOVAs were conducted to examine whether the study variables are different according to the students' sport background, gender, and sport activity (i.e. badminton, basketball, volleyball). All of these analyses were carried out in SPSS version 22.

To test H1, one path analysis including all variables and covariates (see Preliminary Analyses) was conducted. Before doing this, a multilevel model with seven different teachers were firstly estimated (286 students nested within 7 teachers). Accordingly, we estimated the variances at the class

level. The results showed that all interclass correlations were very small (lower than .10) and not significant, suggesting that the assumption of non-independence was not violated (Preacher, Zhang, and Zyphur 2011). Thus, a one-level model was analyzed. In addition, based on the Cohen's Kappa results, we created two separated variables of performance, one for performance measured by teachers, and one for performance measured by a trained observer. To test the study hypotheses, we estimated a model with a path from students' perceptions of teachers' autonomy-supportive teaching styles to students' need satisfaction; from need satisfaction to autonomous motivation; and from autonomous motivation to the students' performance either measured by teachers or measured by trained observer. That is, we examined how teachers' autonomy-supportive behaviors relate to students' need satisfaction, autonomous motivation, and game performance measured both by teachers and by a trained observer.

To test H2, based on Hayes (Hayes 2017), the indirect effects were estimated using 95% bias-corrected bootstrap confidence intervals with 5000 bootstrap samples. Moreover, because there were three sports and they are categorical variables, we created two dummy variables in order to control for variance associated with the type of sport. Path analysis was carried out in Mplus Version 7.4 (Muthen and Muthen 2012).

Results

Preliminary analyses

Table 1 presents means, standard deviations, Cronbach's alphas, and bivariate correlations between all measures employed in this study. Correlations between students' age and each of the study variables were not significant. The multivariate effect of student background [Wilks' Lambda = .90, F (5, 280) = 6.52, $p < .001$, eta = .10], gender [Wilks' Lambda = .76, F (5, 280) = 17.81, $p < .001$, eta = .24] and sport activity [Wilks' Lambda = .59, F (10, 558) = 17.18, $p < .001$, eta = .24] were significant. Univariate tests showed that the students who had a sport background reported higher need satisfaction [F (1, 284) = 14.40, $p < .001$, eta = .05], autonomous motivation [F (1, 284) = 12.60, $p < .001$, eta = .04], and performance either measured by teachers [F (1, 284) = 7.84, $p < .001$, eta = .03] or measured by trained observer [F (1, 284) = 16.40, $p < .001$, eta = .06] than the students who had no sport background. Boys reported higher autonomous motivation [F (1, 284) = 4.48, $p < .05$, eta = .02], and performance measured by trained observer [F (1, 284) = 54.94, $p < .001$, eta = .16] than girls. Univariate tests also showed that students' autonomous motivation [F (2, 283) = 10.35, $p < .001$, eta = .07], and performance measured by trained observer [F (2, 283) = 68.89, $p < .001$, eta = .33] differed according to student sport activities (See Table 1). Considering these findings, we controlled for sport background, gender, and sport activities in the path analysis.

The bivariate correlations showed that perceptions of teachers' autonomy-supportive teaching style positively correlated with students' need satisfaction, and autonomous motivation, but not with performance. Need satisfaction positively correlated with autonomous motivation, and both need satisfaction and autonomous motivation positively correlated with performance either measured by teachers or by trained observer (Table 1).

Primary analyses

The path model showed an excellent fit to data, with the following fit indices: χ^2 (5) = 7.34, p = .53, CFI = 1.00, TLI = .98, RMSEA = .04 [90%CI = .00, .098], SRMR = .015 (Figure 1). Teachers' autonomy-supportive teaching style positively predicted students' need satisfaction (β = .64, $p < .001$), and need satisfaction positively predicted autonomous motivation (β = .61, $p < .001$). Autonomous motivation positively predicted performance either measured by teachers (marginally, β = .11, p = .073) or measured by trained observer (β = .13, $p < .01$). The results of the path analysis also showed that students' sport background positively related to their needs satisfaction (β = .14,

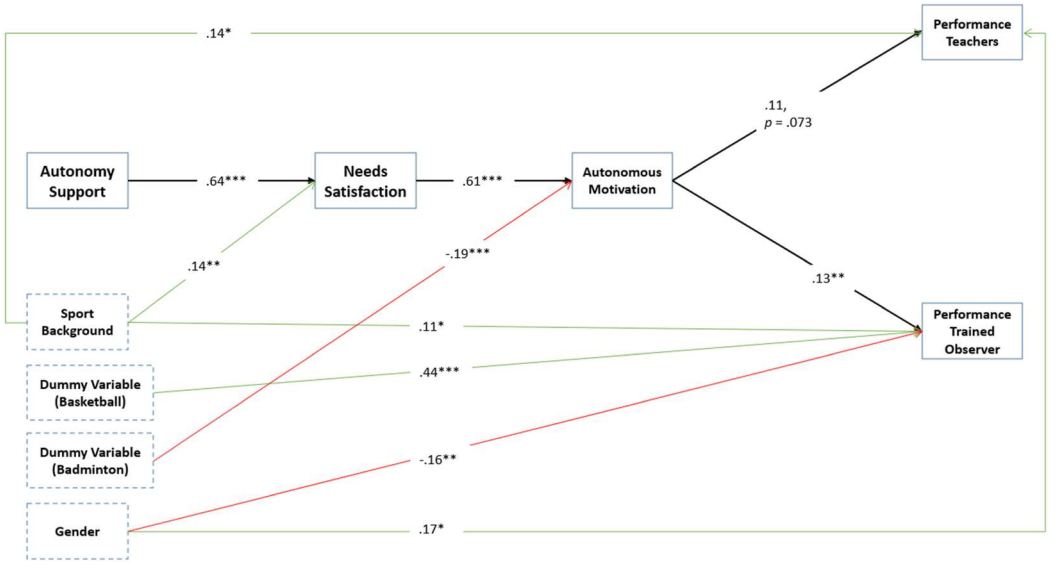

Figure 1. Hypothesized model to test the relations from teachers' autonomy-supportive behaviors toward students' performance measured by both teachers and the trained observer through need satisfaction and autonomous motivation. Covariates are indicated with dashed lines. The coefficients presented are standardized estimates and only significant values are reported. ***$p < .001$, **$p < .01$, *$p < .05$. Performance Teachers = Performance measured by teachers. Performance Trained Observer = Performance measured by the trained observer.

$p < .01$), and both performance measured by teachers (β = .14, $p = .05$) and trained observer (β = .11, $p < .05$). Sport activities, generally, related to autonomous motivation (β = -.19, $p < .001$), and performance measured by trained observer (β = .44, $p < .001$). Students gender also related to their both performance measured by teachers (β = .17, $p = .05$) and trained observer (β = -.16, $p < .01$).

The percentage of variances (R^2) accounted for each variable were as follows: need satisfaction: 44%, autonomous motivation: 47%, performance measured by teachers: 06%, and performance measured by trained observer: 38%. All R^2 were statistically significant at $p < .001$, except for performance measured by teachers ($p = .057$).

Given these direct effects, we estimated the indirect effects proposed in H2. As shown in Table 2, teachers' autonomy-supportive behaviors had a marginally significant indirect effect on performance as measured by teachers (β = .05, 95% CI [.02, .09], $p < .05$), as well as it had significant indirect effect on performance measured by trained observer (β = .04, 95% CI [-.00, .09], $p < .10$). This suggest that need satisfaction and autonomous motivation played positive mediational roles in the relations between autonomy support and performance in high school PE.

Discussion

The overarching goal of the present study was to build on the limited SDT literature examining the link between teachers' autonomy support and students' actual game-play performance. Further, this

Table 2. Indirect effects of teachers' autonomy-supportive behaviors on students' performance via need satisfaction and autonomous motivation.

Total indirect effects	β	95% CI
Autonomy support → need satisfaction → autonomous motivation → performance teachers	.04†	−.00, .09
Autonomy support → need satisfaction → autonomous motivation → performance trained observer	.05*	.02, .09

Note: Performance Teachers = Performance measured by teachers. Performance Trained Observer = Performance measured by the trained observer. †$p < .10$, *$p < .05$.

was the first study to our knowledge to examine these relations among American high school students. Therefore, we examined whether students' basic psychological need satisfaction and autonomous motivation for PE would be important mechanisms underlying this association.

The results showed that teachers' autonomy-supportive teaching styles predicted higher game-play performance in PE. Aligned with previous research that showed teachers' autonomy-supportive behaviors positively related to students' need satisfaction and autonomous motivation in PE (e.g. Leo et al. 2022; Vasconcellos et al. 2020), we found that when students perceived their PE teachers as supportive of their self-determination and decision making, they experienced greater satisfaction of autonomy, competence, and relatedness, and, in turn, were more autonomously motivated in their PE classes. Importantly, these experiences of basic need satisfaction and autonomous motivation, in turn, predicted better game-play performance.

These findings are consistent with Behzadnia et al. (2018) who found that autonomy-supportive teaching predicted Iranian college PE students' performance, and with Haerens et al. (2017) who found that autonomy-supportive coaching was positively related to athletes' performance. The findings are also aligned with past research in the area of general education that has found that autonomy supportive behaviors related to students' academic performance (e.g. learning achievement; León, Núñez, and Liew 2015). This finding adds to the current literature on SDT and PE as it is the first study to our knowledge to find evidence suggesting that an autonomy-supportive teaching style is important for facilitating high school students' real game-play performance. A potential mechanism through which autonomy-supportive behaviors enhance students' performance is that by facilitating student's autonomy satisfaction and autonomous motivation, students can bring their full capacities, ability, and effort into the performance, and wholeheartedly engage in the activity, resulting in an enhanced performance within the game (Ryan and Deci 2017). Taken together, this body of research provides initial evidence that autonomy-supportive teaching styles may not only enhance students' need satisfaction, and autonomous motivation, but also their actual performance at the physical activities.

Practical implications

Although an autonomy-supportive teaching style is sometimes thought to be permissive and thus not likely to impact students' actual game-play performance (Baumrind 1971), the results of the current research show quite the contrary. Not only does teachers' autonomy support predict students' need satisfaction and autonomous motivation toward PE, but it also was indirectly associated with their game-play performance (as measured by external trained observer). Generally, these findings should encourage teachers to implement autonomy-supportive behaviors when instructing students.

What do these behaviors look like in practice? First and foremost, it is important to strive to take students' internal frame of reference when instructing them. Not only will this help teachers meet students' needs, but it will also help them understand and acknowledge students' concerns or negative feelings regarding the tasks. It is also crucial to provide students with a meaningful rationale for engaging in a behavior, especially those that are not intrinsically fun. This rationale will help students find personal value in the task. For example, when instructing students on the fundamentals of a badminton forehand shot, it is important to explain why the practical drills will be useful for their game-play performance. In addition, it is useful, when possible, to provide students with some choice in how they go about the tasks.

The current research also has important implications for the developmental period of adolescence more specifically. By helping students to enhance their perceived competence and, in turn, their autonomous motivation for sports during this early developmental period, they may be more likely to establish regular physical activity habits (e.g. a weekly game of badminton or basketball) that they continue to engage in as an adult. Thus, teachers' autonomy-supportive behaviors may help set adolescents on a healthy trajectory of regular physical activity engagement.

Limitations and directions for future research

The present study is not without limitations. First, given the non-experimental design of the current study, we cannot make cause-and-effect conclusions because we could not control for all potential extraneous variables that might impact students' game-play performance. However, we did control for important third variables, including gender and students' background experience with the sports investigated. Further, it might be that students with higher game-play performance tend to pull autonomy-supportive behaviors out of their teachers. Experimental and longitudinal research designed will help test causality.

The current study has a relatively small sample of students and only students from one school were queried, which limits the external validity of the results. However, the current study does have strong internal validity, given that we measured student's actual game-play performance either measured by teachers or measured by trained observer and perceptions of their teachers' support in PE. Nonetheless, an experimental research design would complement these findings and more clearly show how teachers' behaviors during PE lessons would affect students' outcomes. Next, although a major strength of the current research is that we used a sample of adolescents and examined their actual game-performance result from teachers' autonomy-supportive teaching style, it would be important to examine these associations among an even younger sample of children. For example, would autonomy-supportive teaching in PE facilitate elementary students' autonomous motivation and talent development in a similar fashion as in high school students? Future research with elementary students would be necessary to address this question. In addition, we found the relatively small betas (Table 2) in the paths predicting game performance. We recommend complementing these findings with larger sample sizes and using experimental research designs to further investigate how teachers' interpersonal behaviors would predict students' game performance in school PE programs.

The result of Cohen's Kappa between the expert rater and the teachers was low. A potential explanation might be that teachers were also considering students' general performance when evaluating them using the GPAI, even though they were instructed to only rate students' current performance under observation, and not consider previous experiences. Teachers might also simply value different aspects of students' performance other than their specific game-play performance. In the current study, there was only one expert rather, so the inter-rater reliability for expert raters could not be assessed. Future research could benefit from having multiple expert raters. Moreover, while performance was only measured once in the current study, it would be informative to measure intra-rater reliability across multiple performance assessments in future research.

Finally, we opted to use short versions of several measures because we wanted to support students in focusing on accurately completing the questionnaires, and avoid losing their attention. Although short forms of questionnaires may be somewhat limited in the dimensions of a construct that they can assess (Rolstad, Adler, and Rydén 2011), they often more practical for avoiding survey fatigue given that they are shorter in length, especially for youth. In addition, future research with larger samples of teachers and classes could benefit from using a multi-level approach to the data analysis. Yet, given the novelty of the research questions, the current sample provides a starting point from which future research can build upon.

While the current study focused on the 'bright side' of teaching, namely autonomy-support, need satisfaction, and autonomous motivation, future research would also benefit from examining the 'dark side' of teaching, such as the impact of controlling teaching styles and student's need frustration and controlled motivation on these outcomes. Specifically, it would be interesting to explore whether the dark side of teaching, such as using pressuring and controlling teaching behaviors, negatively relates to students' actual game-play performance in PE. This work may provide important insight into the types of teaching behaviors to avoid, particularly for teachers who believe that more pressure leads to better performance.

Conclusion

The current research makes a significant contribution to the current SDT-based literature in PE in general (e.g. Cheon, Reeve, and Moon 2012; Cheon, Reeve, and Song 2016; Haerens et al. 2017) and to the motor learning literature in particular (e.g. Behzadnia, Mohammadzadeh, and Ahmadi 2019; Wulf et al. 2018). From the lens of SDT, the current study investigated the association between high-school PE teachers' autonomy-supportive teaching and students' actual game-play performance. Overall, the current study contributed to the limited research on the relation between teacher's autonomy support and high school student's actual game play performance. The results demonstrated that teachers' autonomy-supportive behaviors positively predicted students' basic need satisfaction and autonomous motivation, which, in turn, predicted their performance. In addition, the findings offer several practical implications for teachers, as they suggest that taking students' internal frame of reference, respecting their opinions and concerns, and supporting their initiatives and choices, can help students perform better, and acquire new skills in PE. Importantly, by supporting students' autonomy in PE activities at an early age, teachers can help set youth on a healthy trajectory of regular physical activity engagement and develop greater performance.

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No potential conflict of interest was reported by the author(s).

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Appendix

The learning climate questionnaire

This questionnaire contains items that are related to your experience with your instructor in this class. Instructors have different styles in dealing with students, and we would like to know more about how you have felt about your encounters with your instructor. Your responses are confidential. Please be honest and candid. You can choose from 1 to 7 to indicate the degree to which the statement is true for you.

1	2	3	4	5	6	7
not at all true			Somewhat true			Very true

On this PE class …

(1) I feel that my instructor provides me choices and options
(2) I feel understood by my instructor
(3) My instructor conveyed confidence in my ability to do well at the activities
(4) My instructor encouraged me to ask questions
(5) My instructor tries to understand how I see things

Basic psychological need satisfaction and need frustration scale (short form for PE context)

The following statements are about your feelings during PE classes. Please read each of the following items carefully. You can choose from 1 to 7 to indicate the degree to which the statement is true for you.

1	2	3	4	5	6	7
not at all true			Somewhat true			Very true

During the PE lesson …

(1) I felt a sense of choice and freedom in the things I undertake
(2) I felt confident that I could do the exercises well
(3) I felt close and connected to the class members who are important to me
(4) I felt that the exercises reflect what I really want
(5) I felt competent to achieve my goals
(6) I experienced a warm feeling with the class members I spend time with

The learning self-regulation questionnaire

The following questions relate to your reasons for participating actively in this activity of your *Physical Education* (PE) class. Different people have different reasons for their participation in such a class, and we want to know *how true* each of the reasons is for you.

Please use the following scale to indicate how true each reason is for you:

1	2	3	4	5	6	7
not at all true			Somewhat true			Very true

I will participate actively in *the activities:*

(1) Because I feel like its a good way to improve my understanding of the *physical education and sport*
(2) Because a solid understanding of *sports (PE)* is important to my intellectual growth

The reason that I will work to expand my knowledge of *this activities* is:

(1) Because its interesting to learn more about the nature of *sport skills and PE*
(2) Because its a challenge to really understand how to solve *sport skills (PE)* problems