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Original article

Change in Physical Education Motivation and Physical Activity Behavior during Middle School

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Abstract

Purpose: To test a mediational model of the relationships among motivation-related variables in middle-school physical education and leisure-time physical activity behavior.
Methods: Sixth- and seventh-grade physical education students from five middle schools in the midwest United States completed a survey containing measures of study variables on two occasions, 1 year apart.
Results: Motivation-related constructs positively predicted leisure-time physical activity behavior. Enjoyment of activities in physical education and physical activity during class mediated the relationship between self-determined motivation in physical education and leisure-time physical activity. Perceived competence, autonomy, and relatedness were important antecedent variables in the model, with autonomy and relatedness showing less stability over time and positively predicting self-determined motivation.
Conclusions: Students' leisure-time physical activity is linked to motivation-related experiences in physical education. Perceptions of competence, autonomy, and relatedness, self-determined motivation, enjoyment, and physical activity in the physical education setting directly or indirectly predict leisure-time physical activity. The associations suggest that more adaptive motivation corresponds to transfer of behavior across contexts. Also, the findings suggest that the efficacy of school-based physical activity interventions, within and outside of school, is linked to the degree of support for students' self-determined motivation.

Keywords: Adolescence; Basic needs; Self-determination theory; Leisure-time physical activity

Physical activity levels show a pronounced rate of decline during adolescence[1,2], and recent data show that only 36% of grade 9–12 students meet recommended guidelines for physical activity [3]. This is of concern, given the well-known association of physical activity levels with overweight and obesity [2], type 2 diabetes [4], cardiovascular disease risk [5], bone density [6], and mental health [7]. Identifying effective strategies for promoting regular physical activity has potential to enhance the well-being of young people.

Physical education is often credited with impacting children's physical activity-related beliefs and behaviors [8]. However, recent evidence fails to support a consistent link between physical education attendance and physical activity [9]. For example, Wilkin and colleagues [10] showed that variability in physical education attendance explained less than 1% of total physical activity variation. Other research has shown students are more active after school on days they have recess and physical education at school [11]. The reasons for inconsistent findings remain unclear. One possibility is that the quantity of students' exposure to physical education is targeted, but not the *quality* of physical educa-

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tion experiences. One way of examining quality is to consider different types of motivation students experience in physical education.

According to self-determination theory [12,13], individuals possessing motivation that is more self-determined, or derived from within, will experience more positive cognitive, affective, and behavioral consequences. For example, more self-determined motivation is related to greater effort and enjoyment in physical education [14,15], intention to participate in future physical activity [14–17], and physical activity behavior [18]. Further, to experience self-determined motivation students must satisfy their needs to feel competent (i.e., effective), autonomous (i.e., having choices), and related (i.e., socially connected). Sport and physical education research has shown that greater perceptions of competence, autonomy, and relatedness link to more self-determined motivation [17,19,20]. Finally, self-determined motivation should mediate the relationship between need satisfaction and various consequences [21]. Recent physical education studies have supported mediation models in which perceived competence, relatedness, and autonomy relate indirectly to consequences such as effort, intention, and boredom through self-determined motivation [14,17]. However, few have compared these models to alternative models with direct relationships specified between needs and consequences, offering a more rigorous test of the mediating role of self-determined motivation.

Essential for conceptualizing the relationship between physical education and physical activity behavior is the premise that individuals in a setting who are more self-determined will transfer behaviors from that setting to other contexts [21–23]. Recent evidence suggests that such transference is due to the positive consequences likely to result from more self-determined motivation [16,18,23]. For example, in a test of Hagger and Chatzisarantis's trans-contextual model of motivation, cognitions such as attitudes, subjective norms, and perceived control bridged the relationship between self-determined motivation in physical education and leisure-time physical activity [18]. Affective (e.g., enjoyment) and behavioral (e.g., activity levels in physical education) variables also should mediate the relationship between self-determined motivation in physical education and leisure-time physical activity. Indeed, Vallerand's [21] hierarchical model, derived from self-determination theory, suggests that a variety of positive consequences of self-determined motivation within a specific context may explain related consequences outside of that context.

The purpose of this study was to extend recent youth physical activity research by testing a model of relationships to explain the link between experiences in physical education and leisure-time physical activity. The model was grounded in self-determination theory, and special attention was paid to possible mediating pathways of influence on leisure-time physical activity. Furthermore, a longitudinal approach was employed to explain how motivation-related variables in physical education explain leisure-time physical activity while controlling for physical activity levels from the previous school year. It was hypothesized that antecedent variables would positively predict subsequent variables in accordance with the mediational model shown in Figure 1.

Method

Participants and procedures

After securing institutional review board and school personnel approval, fifth and sixth graders from seven elementary and five middle schools in the midwest United States were invited to participate in a 3-year longitudinal project. The present study targets the last 2 years of this larger project, when all students were in middle school. Approximately 50% of invited students returned signed parent consent forms and participated in the study. Each year of the study, during a physical education class, participants completed a questionnaire containing demographic questions and all study measures. All measures were contextualized to physical education except for the physical activity behavior

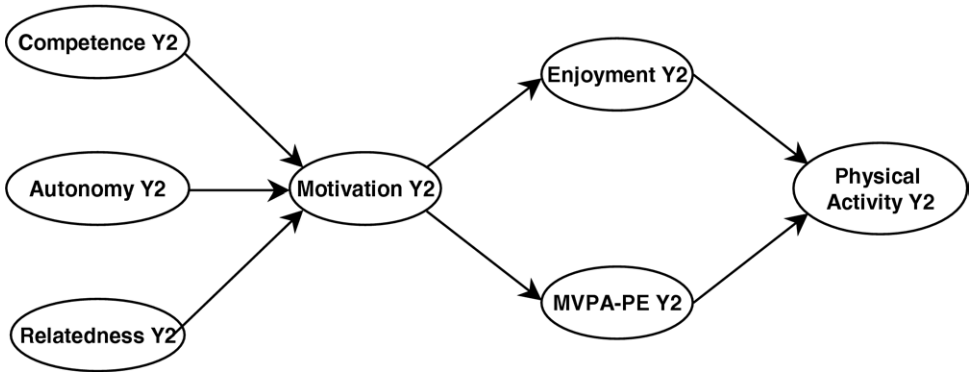

Figure 1. Hypothesized full mediation model of the relationships among movitvation-related variables in physical education and physical activity behavior. Y2 = Year 2. Motivation refers to the self-determined motivation index. MVPA-PE = moderate-to-vigorous physical activity. Observed indicators and correlations among exogenous variables (i.e., competence, autonomy, relatedness) are not shown.

measure. The confidential and voluntary nature of the study was explained before giving instructions and having students complete the questionnaires. Students had attended physical education for at least 10 weeks prior to completing the questionnaire.

In Year 1 of this study, participants were sixth- and seventh-grade middle school students ($N = 463$). Those continuing in Year 2 ($N = 356$; 77%) were in the seventh and eighth grades, respectively. Upon removing 12 cases with missing data, prediction of continuation status by Year 1 demographic (age, grade, gender, race) and study variables was examined via logistic regression. The model was significant (df = 11, $\chi^2 = 48.09$, $p < .01$), with Year 1 grade showing the only significant odds ratio (OR = 4.39, 95%, confidence interval = 2.15–8.96, $p < .01$). Those continuing participation were more likely to be in the higher grade cohort. This reflected discontinued involvement of one seventh-grade physical education teacher, which prevented access to the teacher's students in Year 2. Classification of nonparticipation status was poor (4.9%), however, suggesting the effect is not meaningful.

The 344 cases with complete data ($n = 152$ males, $n = 192$ females) were included in primary analyses. In Year 1, 147 students were in sixth grade and 197 were in seventh grade (mean age = 12.4 years; SD = 0.7). Eighty-seven percent were white, followed by Latino (5.3%), other (3.5%), black (2.3%), American Indian (1.2%), and Asian (0.6%; two participants did not report race). Students attended compulsory physical education five times per week for at least half of the school year. Classes were approximately 40 minutes in duration.

Measures

Perceived competence. The athletic competence subscale of Harter's [24] Self-Perception Profile for Children was modified to assess perceived physical competence in physical education class. The six-item scale measures children's perceptions of ability in sport and other physical games and utilizes a structured-alternative format (e.g., "Some kids do very well at all kinds of sports in P.E., BUT Other kids don't feel that they are very good when it comes to sports in P.E."—select one, then indicate *sort of* or *really* true). Items are scored from one to four with higher values representing higher perceived competence. Reliable and valid scores have been obtained with a similarly modified version of the measure [25].

Perceived autonomy. Four of five items used by Standage et al. [17,20] were modified (e.g., "skills" was changed to "physical activities") to measure students' perceptions of choice in physical education. One item ("I participate in P.E. because I want to") overlapped conceptually with the intrinsic motivation subscale and was not used. Participants responded to items (e.g., "I have a say regarding what physical activities I want to do") on a Likert scale of 1 = *strongly disagree* to 5 = *strongly agree*. Standage et al. [17,20] supported reliability and validity of scores in recent work with young adolescents in physical education.

Perceived relatedness. Five modified items from the Psychological Sense of School Membership Scale [26] assessed feelings of belonging in physical education. Participants responded to items (e.g., "I feel like I'm a part of my P.E. class") on a Likert scale of 1 = *not at all true of me* to 5 = *very true of me*. These items were designed for use in middle-school settings and exhibit reliable and valid scores when modified for physical education [27].

Self-determined motivation. The Academic Self-Regulation Questionnaire [28] was modified to assess self-determined motivation in physical education. The measure included three stems asking about physical education behaviors (e.g., "Why do I participate in the physical activities in PE?"), each followed by eight reasons for engaging in these behaviors, for a total of 24 items. The reasons reflected (six items per motivation type): intrinsic motivation ("Because it's fun"), identified regulation ("Because it's important to me to participate in physical activities in P.E."), introjected regulation ("Because I'll be disappointed with myself if I don't"), and external regulation ("So that the P.E. teacher won't yell at me"). Participants responded to items on a Likert scale of 1 = *not at all true* to 4 = *very true*. The means of the motivation types were used to calculate a relative self-determined motivation index (Intrinsic motivation × 2 + Identified regulation – Introjected regulation – External regulation × 2) with positive scores reflecting relatively self-determined motivation and negative scores relatively non-self–determined motivation [20]. The reliability and validity of scores, similarly modified, have been supported in previous physical education research [20].

Enjoyment. Four items used by Scanlan and colleagues [29] were modified to assess enjoyment of games in physical education. Participants responded to items (e.g., "Do you have fun playing games in PE?") on a Likert scale of 1 = *not at all* to 5 = *very much*. Scores have exhibited reliability and validity in a youth physical activity setting [29].

Physical activity. Seven items from the Physical Activity Questionnaire for Older Children (PAQ-C) [30] assessed physical activity behavior. The PAQ-C is a 7-day physical activity recall assessing engagement in specific physical activities as well as general physical activity levels during different times of day and during each day of the week. The PAQ-C assesses moderate-to-vigorous physical activity (MVPA; i.e., ". . . sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard"). Each item is scored on a five-point Likert scale, with higher values representing higher MVPA levels. The mean of six of the items represented leisure-time physical activity behavior. One item,"In the last 7 days, during your physical

education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)?" represented MVPA during physical education (MVPA-PE). Research with young people supports the reliability and validity of PAQ-C scores [6,30].

Data analysis

Descriptive statistics were generated and a 2 × 2 (Time × Grade) repeated-measures MANOVA conducted to assess change in study variables from Year 1 to Year 2, and if change depended on grade level. Next, structural equation modeling (SEM) was employed using LISREL 8.71 (Scientific Software International, Inc., Chicago, IL) and maximum likelihood estimation. Means of two item parcels served as observed indicators for each latent construct in the measurement models with the exception of self-determined motivation and MVPA-PE. For example, three perceived competence items were randomly selected and averaged to form the first parcel, and the average of the remaining three items served as the second parcel [19]. In the unique case of self-determined motivation, half of the items from each motivation subscale were randomly selected, averaged, and used to calculate one of two index scores to serve as parcels. The remaining items constituted the second index score. The item loading of the first parcel for each latent construct was fixed to 1.0. Parcels are generally more reliable, less likely to violate distributional assumptions, reduce the number of parameter estimates, and are particularly useful when focusing on the relationships among latent constructs [31]. However, parcels should only be used when the underlying factor structure of constructs is well defined as in this study [31]. Following Bollen's [32] recommendations, the uniqueness value for the single-item indicator for MVPA-PE was calculated by subtracting the probable reliability of this type of instrument from one and multiplying that value by the variance of the item. The reliability estimate ($\alpha = .81$) was drawn from a study utilizing a four-item self-report measure of effort in physical education [14] and the measurement error of MVPA-PE was set to 0.285. The covariance matrix was the input file for all SEM analyses.

Recommended procedures [33] were followed in testing proposed mediated relationships using Year 2 data. Specifically, a full mediation model (Figure 1) was compared to an alternative model specifying both direct and indirect relationships from predictor variables. Once the best model fit was determined, Year 1 variables were introduced to model autoregressive effects. In this model, errors associated with observed indicators were correlated across time. Sixty-three Year 1 participants were missing data for MVPA-PE because they were not in class the 7 days prior to data collection. Instead of removing these cases, the autoregressive effect for MVPA-PE was not modeled. The intraclass correlation coefficient for those with MVPA-PE data during both years of the study indicated moderate to low stability of this variable (0.33) across grades. Absolute (χ^2, goodness of fit index [GFI]) and incremental (comparable fit index [CFI]) fit indices as well as the magnitude of residuals (root mean square error of approximation [RMSEA], standardized root mean square residual [SRMR]) were used to assess model fit. An RMSEA value less than 0.08, an SRMR value less than 0.05, and values of 0.90 or greater for both the GFI and CFI suggest a good fit of the model to the data [34]. A significant difference ($p < .01$) in χ^2 between competing nested models was used to determine which best fit the data. In addition to these indices, the strength and direction of path coefficients and variance explained in dependent variables were considered in assessing the validity of the models [35].

Results

Preliminary analyses

Descriptive statistics for both years appear in Table 1. Correlations were in anticipated directions and the measures exhibited good internal consistency reliability, including subscales for calculating self-determined motivation ($\alpha = 0.70–0.93$). The 2 × 2 (Time × Grade) repeated-measures MANOVA revealed only a significant Time effect, $F(6, 337) = 6.69$, $p < .01$; Wilk's Lambda = 0.89; $\eta_p^2 = 0.11$. Univariate tests showed perceived competence, self-determined motivation and enjoyment in physical education decreased significantly ($p < .01$) across school years. Change over time did not depend on grade level.

Measurement model

The measurement model contained both Year 1 and Year 2 variables and errors of observed indicators were correlated across time. Standardized values for multivariate skewness (18.06) and kurtosis (12.55) were significant ($p < .01$). Though estimation techniques for nonnormal data exist, maximum likelihood estimation was employed because it performs well with such data [36]. The measurement model fit the data well (df = 186, $\chi^2 = 236.49$, $p < .01$; GFI = 0.95; CFI = 1.00; RMSEA = 0.03; SRMR = 0.02; see Table 2 for parameter estimates). The fit of a measurement model with factor loadings constrained to be equal across time was not significantly different, $\Delta\chi^2(6) = 9.11$, ns, suggesting consistent factor structure across measurement occasions.

Mediation testing

A full mediation model (see Figure 1) with Year 2 data was tested first and showed a good fit to the data (df = 56, $\chi^2 = 172.89$, $p < .01$; GFI = 0.93; CFI = 0.97; RMSEA = 0.08; SRMR = 0.07). All direct and indirect relationships were significant ($p < .05$). Next, the alternative model specifying both direct and indirect relationships from predictor variables was examined and demonstrated a significantly better, $\Delta\chi^2(7) =$

Table 1
Means, standard deviations, correlations, and scale reliabilities ($N = 344$)

Variable	1	2	3	4	5	6	7
1. Competence	**.79/.80**	.20[b]	.47[b]	.40[b]	.47[b]	.17[b]	.38[b]
2. Autonomy	.15[b]	**.75/.77**	.40[b]	.40[b]	.46[b]	.07	.12[a]
3. Relatedness	.51[b]	.38[b]	**.86/.85**	.58[b]	.65[b]	.21[b]	.34[b]
4. Motivation	.47[b]	.34[b]	.60[b]	—	.64[b]	.30[b]	.29[b]
5. Enjoyment	.52[b]	.41[b]	.67[b]	.68[b]	**.94/.95**	.25[b]	.33[b]
6. MVPA-PE	—	—	—	—	—	—	.33[b]
7. Phys. Activity	.41[b]	.07	.38[b]	.25[b]	.33[b]	—	**.86/.84**
Range	1–4	1–5	1–5	−9–9	1–5	1–5	1–5
M (Year 1)	2.98	2.85	3.92	2.45	4.20	—	3.09
SD (Year 1)	0.68	0.84	0.91	2.51	0.93	—	0.86
M (Year 2)	2.89	2.82	3.85	1.85	4.00	3.71	3.10
SD (Year 2)	0.67	0.85	0.88	2.41	0.97	1.22	0.83

MVPA-PE = moderate-to-vigorous physical activity during physical education.
[a] $p < .05$; [b] $p < .01$. Year 1 correlations below and Year 2 correlations above the diagonal. Year 1 followed by Year 2 Cronbach's α values for internal consistency reliability bolded and on the diagonal. Motivation refers to the self-determined motivation index. MVPA-PE during Year 1 not included because of substantial missing data.

78.24, $p < .01$, fit to the data (GFI = 0.96; CFI = 0.99; RMSEA = 0.05; SRMR = 0.04). In this model, the direct relationships from perceived competence, autonomy, and relatedness to enjoyment were significant ($p < .05$) in addition to all paths of the full mediation model. Indirect paths showed that self-determined motivation partially mediated these relationships. Perceived competence, autonomy, and relatedness did not have direct relationships with MVPA-PE. Also, the direct path from self-determined motivation to leisure-time physical activity was not significant, indicating that enjoyment and MVPA-PE fully mediated this relationship. The nonsignificant paths were dropped and the revised model explained 46% of self-determined motivation, 63% of enjoyment, 13% of MVPA-PE, and 23% of leisure-time physical activity behavior variance. Next, Year 1 variables were controlled for in the revised model (see Figure 2), and errors of observed indicators were correlated across time (df = 230, $\chi^2 = 348.35$, $p < .01$; GFI = 0.93; CFI = 0.99; RMSEA = 0.04; SRMR = 0.04). The significance and strength of the direct paths appear in Figure 2 and the indirect paths in the final model appear in Table 3. Notably, the direct path from perceived competence to self-determined motivation was nonsignificant in this model. The final model explained 65% of perceived competence, 27% of perceived autonomy, 41% of perceived relatedness, 56% of self-determined motivation, 65% of enjoyment, 13% of MVPA-PE, and 49% of leisure-time physical activity behavior Year 2 variance.

Table 2
Measurement model results

Item parcel	Loading	Squared multiple correlation	Uniqueness
Year 1			
Competence A	.77	.59	.41
Competence B	.72	.53	.47
Autonomy A	.83	.69	.31
Autonomy B	.78	.60	.40
Relatedness A	.92	.85	.15
Relatedness B	.83	.69	.31
Motivation A	.89	.78	.22
Motivation B	.90	.80	.20
Enjoyment A	.96	.93	.07
Enjoyment B	.94	.88	.12
Phys. Activity A	.79	.62	.38
Phys. Activity B	.99	.99	.01
Year 2			
Competence A	.88	.78	.22
Competence B	.64	.41	.59
Autonomy A	.92	.85	.15
Autonomy B	.80	.65	.35
Relatedness A	.90	.80	.20
Relatedness B	.85	.72	.28
Motivation A	.90	.81	.19
Motivation B	.90	.81	.19
Enjoyment A	.96	.93	.07
Enjoyment B	.94	.88	.12
MVPA in PE	.90	.81	.19
Phys. Activity A	.74	.54	.46
Phys. Activity B	.98	.95	.05

MVPA = moderate-to-vigorous physical activity.
Standardized loadings and uniquenesses. Motivation refers to the self-determined motivation index. All loadings significant ($p < .05$).

Discussion

In combating youth physical inactivity, regular physical education and adequate levels of physical activity during school have been emphasized. However, limited attention has been paid to how physical activity experiences during school relate to leisure-time physical activity or to mechanisms explaining this relationship. This study extends past research by targeting affective and behavioral aspects of the physical education experience that may foster transference

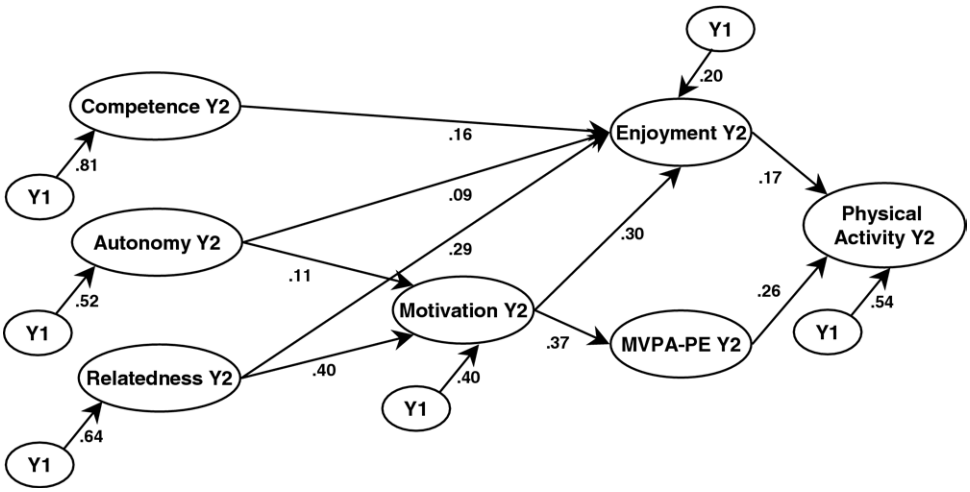

Figure 2. Final model controlling for autoregressive effects. Y1 = variables assessed during Year 1. Motiviation refers to the self-determined motivation index. Observed indicators and correlations among exogenous variables (range = 0.07–0.23) are not shown. All path coefficients are significant ($p < .05$), and values are from the completely standardized solution.

of physical activity behavior outside of physical education. In addition, the longitudinal approach allowed for previous levels of study variables to be controlled. The results suggest that the quality of middle-school students' physical education experiences predicts physical activity outside of the school setting.

The hypothesized sequence of relationships was generally supported in the mediation tests. Self-determined motivation partially mediated the relationships of need satisfaction to enjoyment and MVPA-PE, which in turn, mediated the relationship between self-determined motivation and leisure-time physical activity, supporting self-determination theory [13,21]. Additionally, perceived competence, autonomy, and relatedness directly associated with enjoyment. This contradicts the sequence within Vallerand's model [21], which specifies only indirect paths from need satisfaction to various consequences through motivation. However, the direct relationships support the basic needs subtheory [13] of self-determination theory, which suggests that need satisfaction should directly relate to self-determined motivation and other indices of well-being such as enjoyment.

Table 3
Standardized indirect effects

Path	Effect
Competence → Enjoyment	.01
Autonomy → Enjoyment	.03[a]
Relatedness → Enjoyment	.12[b]
Competence → MVPA-PE	.02
Autonomy → MVPA-PE	.04[a]
Relatedness → MVPA-PE	.15[b]
Competence → Physical activity	.04[a]
Autonomy → Physical activity	.03[b]
Relatedness → Physical activity	.11[b]
Motivation → Physical activity	.15[b]

MVPA-PE = moderate-to-vigorous physical activity during physical education.

[a] $p < .05$; [b] $p < .01$. Motivation refers to the self-determined motivation index.

Stability of variables across years was reflected in the autoregressive effects in the final model. These paths indicated that perceived competence was more stable over time than autonomy and relatedness perceptions. Some students had the same teacher in Year 2 ($n = 164$) as in Year 1, whereas the remaining students had a different teacher in Year 2 ($n = 180$). An anonymous reviewer requested information on how this impacted the stability of perceived competence, autonomy, and relatedness. Therefore, we calculated the intraclass correlation coefficient for these variables by group. The stability of perceived competence (0.66/0.68) and autonomy (0.43/0.44) were nearly identical for both groups of students and the stability of perceived relatedness (0.65/0.52) was slightly higher for those students who had the same teacher both years. This may reflect the relative establishment by middle school of physical competencies, which could be less sensitive to situational influence than autonomy and relatedness perceptions. Autonomy and relatedness perceptions may stem more strongly from situational factors such as social relationships with the physical education teacher and classmates. This interpretation is supported by recent sport motivation research showing that aspects of the social context (i.e., motivational climate) explain more variance in perceived autonomy (15%–25%) and relatedness (21%) change than perceived competence (5%) change across a sport season [37].

The findings indicate that physical educators may be able to promote leisure-time physical activity by supporting self-determined motivation, which may, in turn, encourage greater enjoyment and activity levels during class. Specifically, the

relative stability of study variables suggests that strategies to enhance perceived autonomy and relatedness may be especially effective for supporting self-determined motivation. Physical education research has demonstrated that students experience greater autonomy and social connection in class, as well as competence, when they feel their teacher offers autonomy support [20]. This includes providing choice and rationales for tasks, acknowledging students' perspectives and allowing students opportunities for initiative-taking [38]. In addition, demonstrating care and developing personal relationships with students can foster students' feelings of social connection in class [27]. Incorporating these supportive strategies into physical education may help students experience more self-determined motivation via perceptions of competence, autonomy, and relatedness.

Although this study extends past work, there are limitations that warrant attention in future research. First, including additional measures of physical activity (e.g., accelerometry) in future studies would help confirm the current findings. Second, although the direction of hypothesized relationships aligns with motivation theory, it is plausible that higher engagement in leisure-time physical activity causes students to enjoy physical education more and to be more active during class. Therefore, research enabling causal inferences to be drawn is needed. Third, including more than two data points would allow for modeling individual trajectories of change. Especially interesting would be the inclusion of data points over the summer, allowing assessment of the degree to which physical education experiences predict physical activity behavior during periods of absence from school. Alternatively, obtaining multiple data points across a school year may offer a more fine-grained understanding of how physical education experiences impact adolescent physical activity behavior.

Additional research directions include examining other potential pathways explaining the link between physical education experiences and physical activity outside of school. For example, motivational experiences in physical education may relate more strongly to physical activity outside of school when in-class activities and free-time activities of students closely match. Another possibility is that when students have more fun in physical education they become more self-determined in their motivation for general physical activity, resulting in more activity outside of school. Indeed, Hagger and colleagues [18] have demonstrated the role of self-determined motivation for leisure-time physical activity in the relationship between physical education motivation and physical activity outside of school. However, the role of motivational consequences in physical education (e.g., enjoyment) in this sequence of relationships remains untested.

These research needs acknowledged, the present study offers new information about how students' physical education experiences relate to their leisure-time physical activity and suggests ways that teachers may encourage the transference of physical activity behavior outside of school. Overall, the results showcase the importance of quality, self-determination-supporting experiences in school-based physical activity promotion efforts.

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