Transformational Teaching and Adolescent Physical Activity: Multilevel and Mediational Effects

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Abstract

Background Regular physical activity is associated with a range of physical and psychological health benefits. In North America the majority of adolescents are insufficiently active.
Purpose The purpose of this study was to examine the prospective relationship between adolescents' perceptions of transformational leadership displayed by their school physical education teachers and their own physical activity behaviors, both with respect to within-class physical activity (WCPA) and also leisure time physical activity (LTPA).
Method The study used a prospective observational design. Using multilevel structural equation modeling (MSEM), we examined the extent to which adolescents' affective attitudes mediated the effects of teachers' behaviors on adolescents' physical activity responses. Two thousand nine hundred and forty-eight adolescents (M_{age}=14.33, SD=1.00, N_{female}= 1,641, 55.7 %) from 133 Grade 8–10 classes in British Columbia (Canada) provided ratings of their physical education teachers' behaviors midway through the school year. Two months later, students completed measures of affective attitudes, WCPA, and LTPA.
Results The results indicated that adolescents' perceptions of transformational teaching explained significant variance in both WCPA and LTPA, and these effects were fully mediated by adolescents' affective attitudes (total indirect effect: b=0.581, p<0.001).
Conclusion The findings suggest that transformational leadership behaviors displayed by physical education teachers may be an important source of adolescent enjoyment of physical education as well as health-enhancing physical activity involvement within school *and* outside of school.

Keywords Transformational leadership · Multilevel structural equation modeling · Adolescents · Affective attitudes · Physical activity

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Introduction

There is now considerable evidence that regular participation in physical activity is associated with a diverse range of physical and psychological health benefits among children and adolescents [1], and that when youth are physically active, this is associated with longitudinal improvements in academic performance [2]. In light of the diverse health benefits associated with physical activity for children and adolescents, the World Health Organization [3] published a set of physical activity guidelines for those between the ages of 5 and 17 years, indicating that youth should engage in at least 60 min of moderate-to-vigorous physical activity per day. In North America, the overwhelming majority of this population do not meet these recommendations, with more than 90 % of adolescents from Canada and the United States estimated to be insufficiently active [4, 5].

In the context of this epidemiologic evidence, a number of scholars have advocated the need for schools, and in particular school physical education, to take a prominent

role in promoting physical activity within school hours and encouraging physical activity participation among children and adolescents during their own leisure time [6–8]. In spite of the *potential* for school-based physical education to act as a prepotent context to promote long-term health-enhancing physical activity participation [9], much remains to be learned in terms of the mechanisms through which physical education might translate into active lifestyles among youth.

Transformational leadership theory [10–12] represents a theoretical framework that has recently been applied to understanding the effects of physical education teachers' behaviors in relation to the motivational, affective, and behavioral responses of their students [13] and has considerable potential to shed light on these (psychological) mechanisms. Originally conceived within organizational and political contexts, transformational leadership is concerned with actions that transcend one's own self-interests with the purpose of empowering, inspiring, and stimulating others to exceed minimally expected standards and achieve higher levels of functioning [12]. In a range of occupational contexts (e.g., financial services, multi-national project teams, military combat units, and hospitals), displays of transformational leadership have been found to predict a wide range of adaptive responses among followers including elevated levels of job satisfaction, effort, achievement, and objective measures of performance [14, 15].

In the contexts of educational and health psychology, research evidence has accumulated in support of the predictive utility of physical education teachers' *transformational teaching* behaviors [13] in relation to various health-enhancing outcomes among adolescents. As with transformational leadership [12], transformational teaching is comprised of four interrelated behavioral dimensions that include idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration [12, 13, 16]. *Idealized influence* takes place when teachers act as role models, articulate and embody their personally valued beliefs (i.e., doing what's right because it's the right thing to do), and engender the trust and respect of their students. *Inspirational motivation* involves conveying a compelling vision of what students are capable of achieving as well as displaying optimism, enthusiasm, and communicating high expectations to students about what they can accomplish. *Intellectual stimulation* involves engaging the rationality of students and encouraging them to look at issues from different angles, and getting them to question commonly held assumptions. Lastly, *individualized consideration* takes place when teachers are sensitive to, and act with due concern for, students' physical and psychological needs and, in so doing, interact with students through a genuine sense of care and empathy.

Within the context of school-based physical education, transformational teaching behaviors have been found to be related to greater self-determined motivation and elevated affective responses among students towards physical education [17] as well as improved student psychological need

satisfaction and engagement behaviors [18]. Results of a randomized controlled feasibility trial also suggest that transformational teaching behaviors can be developed through intervention/training, which results in improvements among students in their self-efficacy beliefs, intrinsic motivation, and intentions to engage in leisure time physical activity [19]. Although social cognitions such as self-efficacy [20], self-determined motivation [21], and intentions [22] have each been implicated in the prediction of physical activity behaviors in previous research, research has yet to examine the extent to which transformational teaching behaviors predict physical activity behaviors among adolescents, either with respect to within-class activities or leisure time activities. Thus, the overall purpose of this study was to examine the prospective relationships between adolescents' perceptions of their respective physical education teachers' transformational teaching and their own physical activity behaviors in two (i.e., within-class and leisure time) contexts.

In this study, we were also interested in the extent to which students' affective attitudes towards school physical education mediates the effects of transformational teaching behaviors in relation to both within-class (WCPA) and leisure time physical activity (LTPA) behaviors. Affective attitudes correspond to how enjoyable (or unenjoyable) an activity is perceived to be [23, 24]. Several contemporary models of physical activity incorporate affective judgments in one form or another (for an extended discussion see [25]). This is perhaps unsurprising given that across life contexts, the level of affect experienced in a given situation has been found to be a consistent predictor of the amount of time people choose to spend in that situation [26]. In a recent meta-analytic review of studies involving adolescents, affective attitudes (as conceptualized across diverse theoretical perspectives) were found to consistently predict physical activity behaviors [25]. Within the organizational psychology literature, transformational leadership behaviors are associated with improved affective responses [14], and previous research in educational settings has demonstrated that physical education teachers' use of transformational leadership is significantly related to enjoyment of physical education among their students [17, 27]. Thus, it was expected that transformational teaching behaviors by school physical education teachers would be related to improved physical activity behaviors among their students and that students' enjoyment (affective attitudes) of physical education classes would mediate that relationship.

Because WCPA behaviors are more proximal to the teacher's behaviors than LTPA (which take place away from the school context), we further expected that the relationships between transformational teaching and WCPA would be stronger than the relations between transformational teaching and LTPA [13]. Nevertheless, if transformational teaching behaviors do inspire adolescents to exceed minimally expected standards, as is posited by the tenets of transformational leadership

theory [12], and foster interest in health-enhancing physical activity away from the school [9], one would also expect that these teaching behaviors would transcend school confines and predict physical activity behavior during student leisure time. When taken together, it was expected that transformational teaching behaviors by school physical education teachers would be related to elevated WCPA by adolescents and that adolescents' enjoyment of physical education class (affective attitudes) would mediate that relationship. It was also expected that transformational teaching behaviors by physical education teachers would predict LTPA by students and that adolescents' enjoyment of school physical education (affective attitudes) would mediate that relationship. Thus, it was hypothesized that:

Hypothesis 1	Transformational teaching behaviors, as displayed by physical education teachers, will be related to higher levels of WCPA by adolescents and that adolescent enjoyment of physical education will mediate those effects.
Hypothesis 2	Transformational teaching behaviors, as displayed by physical education teachers, will be related to higher levels of LTPA by adolescents and that adolescent enjoyment of physical education will mediate those effects.

Methods

Participants

Two thousand nine hundred and forty-eight students (M_{age}= 14.33, SD=1.00, $N_{females}$=1,641, 55.7 %) from 133 Grade 8–10 classes from six schools in the Lower Mainland of British Columbia (Canada) volunteered to participate in this study[1,2].

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[1] Data reported in the present study formed part of a larger program of research designed to examine the effects of transformational teaching in physical education contexts. Research on the reliability and validity of measures derived from the TTQ were previously published in Beauchamp et al. [17] and concerned data collected midway through the school year (Time 1). The data reported in this article represents longitudinal data, with respect to Time 1 measures of transformational teaching in relation to Time 2 (2 months later) measures of affective attitudes and physical activity behavior among adolescents.

[2] It should be noted that the sample size reported in this study was different to that reported in Beauchamp et al. [17] due to both the different approaches to dealing with missing data as well as the different methods of model estimation in the two studies. In the measurement development paper by Beauchamp et al. [17], missing data were dealt with through listwise deletion (prior to conducting the multilevel CFA, missing data were found to be Missing Completely at Random, MCAR, Little's chi square=ns). In light of recent advances in treating missing data [48, 49], missingness was modeled in the current study within the WLSMV estimation algorithm [39]. In addition, in the current study, sex was included as a covariate within the analyses, which meant that data were included in this study only if participants reported their sex (in the initial instrument development study by Beauchamp et al. [17], 24 participants did not report their sex).

The average within-class size was n_g=22.17. Adolescents in this study represented a diverse range of ethnic backgrounds. We delimited our study to Grade 8–10 students for the reason that, in British Columbia, physical education classes were mandatory for students in these grades and, as such, it was anticipated that a range of physical activity-related cognitions and behaviors would be observed. It is also around this age (i.e., in the midteens) that notable declines in physical activity occur [28]. We followed procedures used by Statistics Canada [29] in their 2001 census and allowed participants to identify all ethnic and/or cultural groups with which they self-identified (i.e., students could identify with more than one ethnic group). The largest represented ethnic groups were Canadian (57.8 %), Chinese (54.1 %), East Indian (9.8 %), Filipino (7.8 %), British (7.4 %), Vietnamese (5.6 %), and Irish (5.2 %). Eighteen other ethnic groups were identified with a frequency of less than 5 %. Most participants (61.9 %) were born in Canada, 18.6 % were born in China, and 83 other countries were identified as a place of birth with a frequency of less than 5 %. In sum, our sample was representative of the racial composition of this area of Canada [29].

Measures

Transformational Teaching

Adolescents' perceptions of their teachers' behaviors were measured using the 16-item Transformational Teaching Questionnaire (TTQ) developed by Beauchamp et al. [17]. This instrument was developed specifically for use with adolescents in school-based physical education contexts and contains separate subscales designed to assess the four dimensions of transformational teaching, with four items per subscale. Within the TTQ, items are prefixed with the stem "My physical education teacher…" and includes items such as "acts as a person I look up to" (idealized influence), "is optimistic about what I can accomplish" (inspirational motivation), "encourages me to look at issues from different sides" (intellectual stimulation), and "tries to help students who might be struggling" (individualized consideration). Responses were provided on a five-point rating scale with anchors ranging from 0 (not at all) to 4 (frequently). In their instrument development work, Beauchamp et al. [17] provided evidence for the factorial validity of measures derived from the TTQ. Specifically, through use of multilevel confirmatory factor analyses, Beauchamp et al. [17] provided evidence for a second-order measurement model with the four transformational teaching dimensions contributing towards a higher order latent dimension of transformational teaching. In the present study, scores derived from each of the four subscales were found to be internally consistent with an ordinal coefficient alpha [30] of ≥0.83.

Adolescent Affective Attitudes

Adolescents' affective attitudes towards physical education were assessed using the interest/enjoyment subscale of the Intrinsic Motivation Inventory (IMI; [31]). This instrument includes five items that are anchored on a 1 (strongly disagree) to 7 (strongly agree) Likert-type scale. As with previous research in physical education, items were prefixed by the stem "In this PE class I feel…" and included items such as "I enjoy PE very much", "While I'm in PE I am thinking about how much I am enjoying it", and "PE is fun." Consistent evidence has accumulated in support of the reliability and construct validity of measures derived from the interest/enjoyment subscale of the IMI within physical education settings [32, 33]. In the current study, the interest/enjoyment measure displayed an acceptable level of internal consistency (ordinal coefficient alpha=0.89).

Adolescent Physical Activity Behaviors

Adolescent physical activity behaviors were assessed using the Physical Activity Questionnaire for Adolescents (PAQ-A) developed by Kowalski et al. [34]. The PAQ-A is a self-administered 7-day recall questionnaire that measures moderate-to-vigorous physical activity during the school year. In a recent review of 89 self-report physical activity instruments, Biddle et al. [35] identified the PAQ-A as being one of three instruments that are particularly suitable for use with adolescents in population-level surveillance research, tracking physical activity trends over time. Measures derived from this instrument have been found to demonstrate sound reliability as well as convergent validity in relation to objective measures of physical activity [34, 36]. In this study, we used separate indicators within the PAQ-A to assess physical activity expenditure (a) during physical education classes, (b) right after school, (c) during evenings, and (d) on the previous weekend. Adolescents' responses to each of these items were anchored on five-point scales. Within-class physical activity (WCPA) was assessed with the one-item measure "in the last 7 days, during your physical education classes, how often were you very active (playing hard, running, jumping, throwing)." The "right after-school", "evening", and "weekend" measures were combined to form a composite measure of leisure time physical activity (LTPA) that was found to be internally consistent (ordinal alpha=0.85).

Procedures

Ethical approval was obtained from the lead author's Behavioral Research Ethics Board along with school board approval. Students and their parents received a letter informing them of the overall purpose of the study and inviting them to participate. Passive consent was obtained from parents, who were provided the opportunity to opt their child out of the study, and active informed consent was provided by adolescents. Data collection initially took place midway through the school year (Time 1 Assessment: January) in order to ensure that students had a sufficient frame of reference with which to assess their teachers' behaviors and also to minimize any honeymoon biases that may occur as a result of students appraising their "new" teachers at the beginning of the school year [37, 38]. At this point, students completed demographic measures and ratings of their teachers' behaviors. Two months later (Time 2: March), students completed measures related to their affective attitudes and physical activity behaviors.

Data Analysis

A missing value analysis was conducted using SPSS 19.0 and revealed to be significant, Little's chi square test, $\chi^2(192)=277.39$, $p<0.001$. Specifically, on the basis of those participants that provided data at Time 1 (T1), there were missing data between 20.3 and 21.8 % of the Time 2 (T2) study variables (i.e., complete data were provided at both time points for between 78.2 and 79.7 of adolescents). Further inspection of the data revealed that a greater proportion of boys did not provide data at T2 (24–25.2 %) relative to girls (16.4–18.2 %) on the study variables. In addition, for all outcome variables (WCPA and LTPA) and the mediator (affective attitudes), adolescents who did not provide data at T2 were found to report lower scores on the four dimensions of transformational teaching with the resulting t tests ranging from 3.085 to 6.165. However, the effect sizes for all the mean differences were small (Cohen's d ranged from 0.148 to 0.318). In the subsequent path analysis, we included adolescent sex as a covariate [39], and four dimensions of transformational teaching as predictors.

In light of the fact that the data were nested (students within classes), we examined the prospective relations between adolescents' perceptions of transformational teaching, their affective attitudes, and physical activity behaviors through a multilevel modeling framework. Specifically, Preacher et al. [40] recently developed an approach for assessing multilevel mediation through multilevel structural equation modeling (MSEM). Through this approach, researchers are able to simultaneously estimate a number of mediational relationships and provide inferential tests of overall model fit. In addition, this approach can handle nested data while also reducing bias in parameter estimates; in so doing, it is possible to investigate mediation at both the individual and group levels through use of a latent variable decomposition framework.
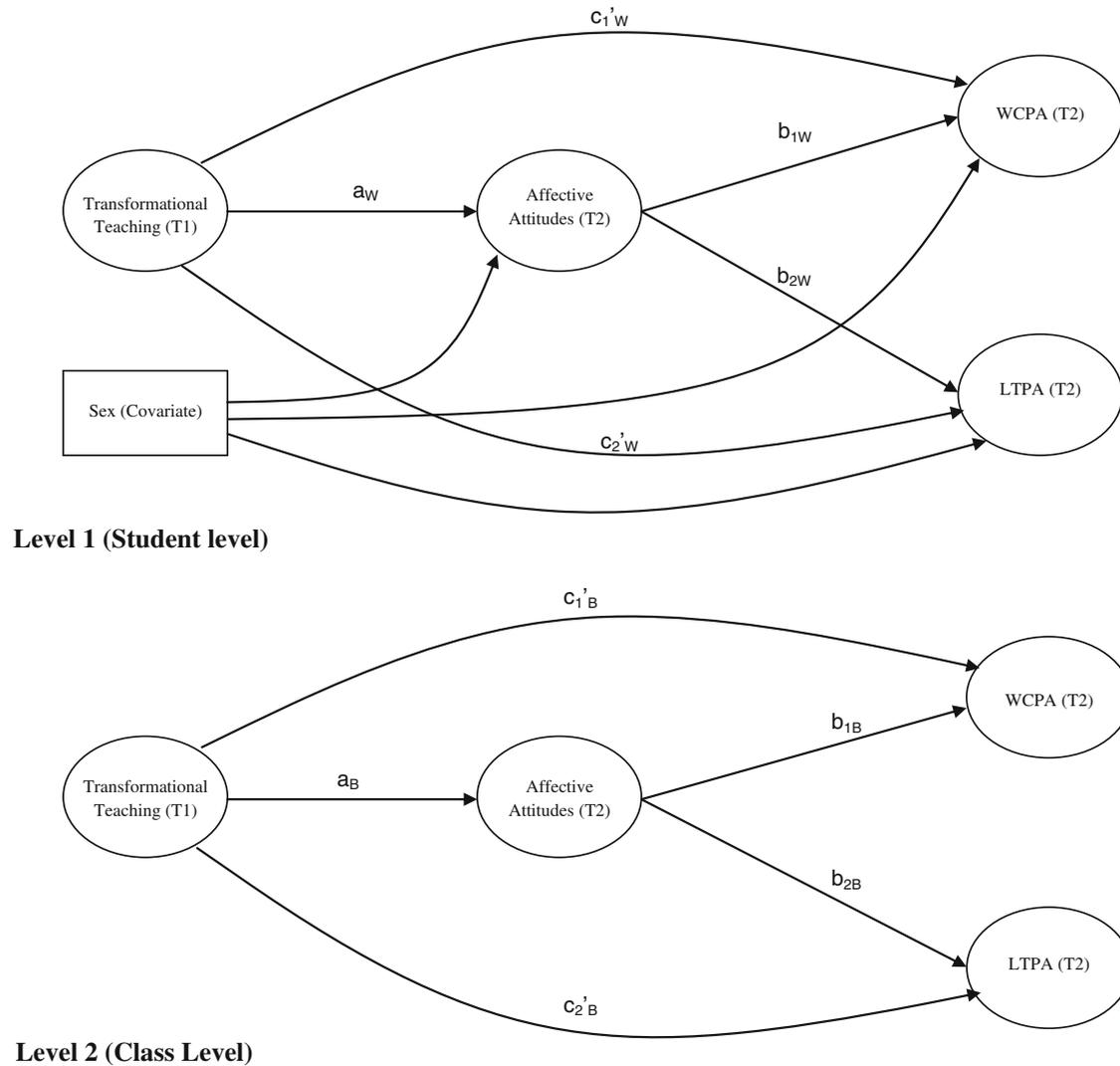
Fig. 1 Path diagram of the hypothesized relationships between transformational teaching, adolescents' affective attitudes, and physical activity behaviors at levels 1 and 2. *T1* time 1, *T2* time 2, *LTPA* leisure time physical activity, *WCPA* within-class physical activity

In the current study, the a priori hypothesized model (see Fig. 1) was tested using Mplus 6.11 [41] software using a weighted least squares mean and variance-adjusted (WLSMV) method of estimation, which incorporates full information maximum likelihood (FIML) estimates at the initial stage of the estimation. Using all available data, Asparouhov and Muthén [39] showed that WLSMV estimator can estimate missing values appropriately based on the assumption of MAR in their simulation studies.

This MSEM approach allows for the inclusion of both observed and latent variables with embedded measurement models that can improve model parameter estimates with reduced measurement error [40, 42, 43]. In this study, we used multiple indicators to construct latent variables for transformational teaching (four dimensions, using total scores of four subscales; idealized influence, inspirational

motivation, intellectual stimulation, and individualized consideration), enjoyment (five items), and LTPA (three items). It is worth noting that WCPA was assessed with a one item measure. However, as this was decomposed at both the individual and group levels, WCPA was represented as a latent variable rather than an observed variable in the model. In addition, sex was included as a covariate at the individual level in relation to affective attitudes, WCPA, and LTPA. The structural model included tests of direct and indirect predictive pathways between transformational teaching, adolescent affective attitudes, and both WCPA and LTPA. We assessed model fit using χ^2 goodness-of-fit index, root-mean-square error of approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square residual (RMSR) at both the individual and group levels (cf. 40).

The upper part of Fig. 1 shows the mediation model for the student level (Level 1) and the lower part for the class level (Level 2). Following Baron and Kenny's [44] conceptual approach to describing mediation, path a is the relationship between the predictor (transformational teaching) and the mediator variable (affective attitudes), path b is the effect of the mediator variable on the outcome variable (b_1 for WCPA and b_2 for LTPA), and path c' is the direct effect of the predictor on the outcome variable after controlling for the mediator. The indirect effect was calculated using $a*b$. In Fig. 1, we specified "$_W$" after these paths to indicate student-level coefficients and "$_B$" to denote class-level coefficients. Specifically, we examined two mediation effects (at both the individual and class levels) that included $a*b_1$ and $a*b_2$ separately as well as the total indirect effect $a*b_1+a*b_2$ [45]. Preacher et al. [39] indicated that no centering is required when this MSEM approach is applied to raw data, and as such, no centering approach was utilized with the data prior to conducting the MSEM analyses.

Results

Descriptive statistics are reported in Table 1. The ICCs for the four transformational teaching measures displayed some degree of "groupness" (ICCs=0.15 to 0.26), whereas for each indicator of the mediator (affective attitudes) and outcome variables (LTPA and WCPA), the overwhelming majority of variance was observed at the individual level (ICCs= 0.02 to 0.07). The fit indices for our a priori hypothesized model (that simultaneously incorporated measurement parameters along with the specified structural pathways) were:

χ^2 (144)=1,777.654, $p<0.001$, RMSEA=0.062, CFI=0.935, TLI=0.924, SRMR$_{within}$=0.054, SRMR$_{between}$=0.131.

Path analyses revealed significant effects at Level 1 (student level) between transformational teaching and students' affective attitudes ($b=0.409$, $p<0.001$) and between affective attitudes and both WCPA ($b=0.438$, $p<0.001$) and LTPA ($b=0.391$, $p<0.001$) (see Table 2, Fig. 2). With the inclusion of sex as a covariate at the student level, the results revealed that boys were more likely to enjoy physical education than girls ($b=-0.233$, $p<0.001$), and girls reported slightly greater physical activity involvement in classes (WCPA) than boys although the effects were small ($b=0.064$, $p=0.016$). There were no effects for sex on LTPA.

With regard to the main findings, the results revealed evidence for full mediation in the relationships between transformational teaching and both WCPA and LTPA. That is, the indirect effect for WCPA at the student level, a_W*b_{1W}, was significant ($b=0.284$, $p<0.001$), with 18.8 % of the variance in WCPA explained at the student level ($R^2=0.188$). The indirect effect for LTPA at the student level, a_W*b_{2W}, was also significant ($b=0.297$, $p<0.001$), with 16.1 % of the variance in LTPA explained at the student level ($R^2=0.161$). After accounting for the effects of affective attitudes (mediator), the direct effects for transformational teaching in relation to both WCPA ($b=0.014$, $p=0.580$) and LTPA ($b=-0.014$, $p=0.586$) were nonsignificant, which suggests that full mediation was evident in both instances. The total (within-level) indirect effect, $a_W*b_{1W}+a_W*b_{2W}$, was also significant ($b=0.581$, $p<0.001$).

At Level 2 (class level), transformational teaching predicted affective attitudes ($b=0.799$, $p<0.001$). However, none of the other direct or indirect effects at the group level were statistically significant (see Table 2), probably because

Table 1 Descriptive statistics, intraclass correlations, and ordinal alpha coefficients

Variable	M	SD	Skewness	Kurtosis	ICC	α
1.Transformational teaching (4 subscales)						
II	2.554	0.947	−0.599	−0.088	0.233	0.843
IM	2.708	0.953	−0.776	0.222	0.199	0.876
IS	2.304	0.958	−0.437	−0.288	0.153	0.831
IC	2.857	0.909	−0.903	0.447	0.255	0.847
2.Enjoyment (5 items)						0.890
Item #1	4.958	1.578	−0.573	−0.235	0.065	
Item #2	5.118	1.596	−0.750	0.027	0.069	
Item #3	4.860	1.566	−0.567	−0.143	0.065	
Item #4	4.261	1.689	−0.163	−0.679	0.046	
Item #5	4.728	1.696	−0.394	−0.616	0.030	
3.LTPA (3 items)						0.854
Item #1	2.703	1.301	0.268	−0.901	0.038	
Item#2	2.566	1.240	0.296	−0.849	0.041	
Item #3	2.709	1.190	0.238	0.679	0.020	
4.WCPA	3.913	0.966	−0.758	0.299	0.022	−

LTPA Leisure time physical activity, *WCPA* within-class physical activity, *II* idealized influence, *IM* inspirational motivation, *IS* intellectual stimulation, *IC* individualized consideration

Table 2 Multilevel structural equation modeling mediation analysis of effects of transformational teaching on student physical activity behavior

Variables	Estimate	SE	p value	95 % CI
Within level				
Path a (outcome: AA)				
Predictor: TT (a_W)	0.409	0.018	<0.001	0.374–0.443
Covariate: sex	−0.233	0.027	<0.001	−0.287−−0.180
Paths b and c (outcome: WCPA)				
Mediator: AA (b_{1W})	0.438	0.020	<0.001	0.399–0.477
Predictor: TT (c_{1W}')	0.014	0.025	0.580	−0.035–0.063
Covariate: sex	0.064	0.027	0.016	0.012–0.116
Paths b and c (outcome: LTPA)				
Mediator: AA (b_{2W})	0.391	0.025	<0.001	0.343–0.440
Predictor: TT (c_{2W}')	−0.014	0.026	0.586	−0.064–0.036
Covariate: sex	−0.053	0.028	0.062	−0.108–0.003
Between level				
Path a (outcome: AA)				
Predictor: TT (a_B)	0.799	0.068	<0.001	0.666–0.932
Paths b and c (outcome: WCPA)				
Mediator: AA (b_{1B})	0.303	0.436	0.487	−0.551–1.157
Predictor: TT (c_{1B}')	0.230	0.402	0.567	−0.557–1.017
Paths b and c (outcome: LTPA)				
Mediator 1: AA (b_{2B})	0.166	0.359	0.644	−0.538–0.870
Predictor: TT (c_{2B}')	−0.096	0.335	0.775	−0.753–0.561
Indirect effects				
Within level				
a_W*b_{1W}	0.284	0.020	<0.001	0.244–0.324
a_W*b_{2W}	0.297	0.026	<0.001	0.245–0.349
$a_W*b_{1W}+a_W*b_{2W}$	0.581	0.040	<0.001	0.502–0.660
Between level				
a_B*b_{1B}	0.092	0.138	0.505	−0.178–0.361
a_B*b_{2B}	0.089	0.196	0.649	−0.296–0.474
$a_B*b_{1B}+a_B*b_{2B}$	0.181	0.268	0.499	−0.344–0.706
R^2				
Within level				
WCPA	0.188	0.014	<0.001	
LTPA	0.161	0.016	<0.001	
Between level				
WCPA	0.256	0.170	0.132	
LTPA	0.011	0.043	0.792	

Standardized regression coefficients are reported

AA Affective attitudes, *WCPA* within-class physical activity, *LTPA* leisure time physical activity

the overwhelming majority of variance in the criterion measures was observed at the student level (ICCs indicated that 2.2 % of the variance in WCPA and between 3.0 and 4.1 % of the variance for LTPA indicators was observed at the group level). In sum, the main finding from the MSEM is that the majority of variance in both WCPA and LTPA was observed at the student level and that transformational teaching predicted significant variance in both outcome variables, and these prospective relationships were fully mediated by student enjoyment of physical education.

Discussion

The purpose of this study was to examine the prospective relationships between adolescents' perceptions of transformational teaching, as displayed by their school physical education teachers, and their (within-class *and* leisure time) physical activity behaviors. The results of this study revealed that transformational teaching predicted WCPA at the student level and this relationship was fully mediated by adolescents' affective attitudes (i.e., enjoyment) towards
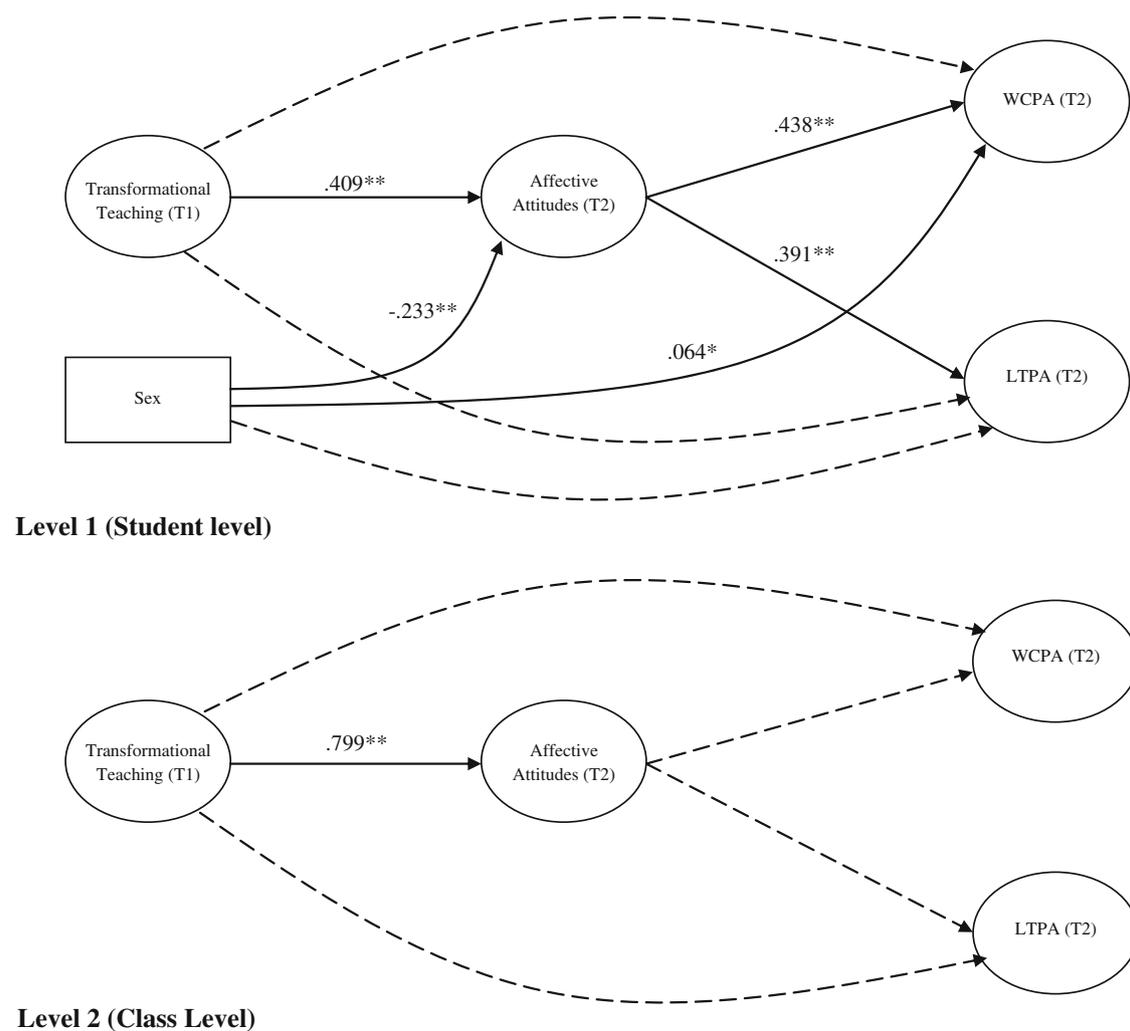
Level 1 (Student level)

Level 2 (Class Level)

Fig. 2 Path diagram of the relationships between transformational teaching, adolescents' affective attitudes, and physical activity behaviors. *Solid lines* represent significant path coefficients (standardized) and *dashed lines* represent nonsignificant path coefficients. *$p<0.05$,

**$p<0.001$. Only significant paths are highlighted in the path model (see Table 2 for all significant and nonsignificant path coefficients). *T1* time 1, *T2* time 2, *LTPA* leisure time physical activity, *WCPA* within-class physical activity

physical education. Of considerable note, however, this mediational effect for affective attitudes acting as an explanatory mechanism linking transformational teaching and physical activity was also evident for leisure time behaviors among adolescents as well. This finding lends support for the theoretical tenet that when people make use of transformational leadership behaviors, this encourages those being led (e.g., students) to exceed minimally expected standards [12]. In the context of the present study, when teachers had no direct control of their students, a transformational teaching style predicted students' choice of physical activity away from the teachers (i.e., during leisure time).

Because the within-class behaviors of students are subject to greater influence by teachers than the behaviors of students away from the school (LTPA), one would expect that the effects of transformational teaching would be more

pronounced for WCPA than LTPA (cf. 13). The results of this study are consistent with this contention, with 18.8 % of the individual-level variance in WCPA explained by transformational teaching and students' affective attitudes, and 16.1 % of the individual-level variance in LTPA explained by those same variables. Nevertheless, the finding that 16.1 % of the student-level variance in LTPA was explained by transformational teaching and students' affective attitudes substantively underscores the role of physical education teachers. Indeed, it has been suggested that school-based physical education has the potential to influence youth to adopt and sustain health-enhancing physical activity [8, 9]. The findings of the current study represents one mechanism, whereby the (transformational) behaviors that physical education teachers use in their interactions with their students have the potential to predict students' enjoyment of physical

education, which in turn, predicts their pursuit of leisure time active behaviors.

In spite of the potential contributions of this study, limitations should also be acknowledged. In particular, the criterion measures of physical activity used in this study were assessed through self-report, rather than through objective measures. That said, the sheer scale of this study, with 2,948 students from 133 classes, meant that collecting objective measures (e.g., accelerometers, doubly labeled water) was not feasible. Within these constraints, we were aware of the need to use a (self-report) measure of physical activity that not only demonstrates sound reliability and validity but that is also suitable and feasible for surveillance research. With this in mind, the PAQ-A [34] seemed well justified [35]. It is also pertinent to note that although prospective designs (that involve temporal separation of the predictor and criterion measures) are preferable to cross-sectional approaches, insofar as they alleviate concerns associated with common method bias [46], it should be noted that the observational nature of our study does not provide any evidence of causality. Previous experimental research from organizational [47] as well as educational [19] settings suggest that transformational leadership can be developed through training, and thereafter, result in improved follower outcomes. In the current study, we used a nonexperimental design that precludes any causal inferences that transformational teaching influenced the adoption and maintenance of health-enhancing physical activity behaviors among adolescents. Finally, it is also noteworthy that the current study used a relatively short sampling frame that examined perceptions of transformational teaching in relation to physical activity behaviors 2 months later. Future research that utilizes a longer (e.g., 6 months, 1 year) sampling frame would certainly appear warranted. Nevertheless, the results of this study do point to a potential explanatory mechanism that might form the basis of future field-based experimental research that tests the effects of transformational teaching. Specifically, in light of the fact that adolescent affective attitudes fully mediated the effects of teachers' behaviors in relation to adolescent WCPA and LTPA, future experimental work is encouraged that tests the capability of transformational teaching behaviors to *improve* student enjoyment of physical education and physical activity, and thereafter health-enhancing behavioral outcomes.

In summary, the results of the current study are noteworthy for several reasons. First, through use of multilevel modeling within a structural equation modeling framework, the findings revealed that transformational teaching predicted significant variance in within-class and leisure time behaviors among adolescents. Furthermore, adolescents' affective attitudes mediated those relationships. In light of recent evidence that affective attitudes are significantly implicated in the prediction of physical activity behaviors [25], the results of the present study lend support for the notion that "how teachers interact with their students" can have a substantive effect on how much students enjoy physical education, which in turn, may translate into their volitional behaviors. In conclusion, future research is warranted that tests these mediational effects through use of experimental designs (i.e., randomized controlled trial) and with objective measures of health-enhancing physical activity.

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