

The relative roles of physical education teachers and parents in adolescents' leisure-time physical activity motivation and behavior

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ABSTRACT

Objectives: The purpose of this study was to explore the relative contributions of perceived parent and physical education teacher autonomy support, involvement, and modeling to adolescent leisure-time physical activity motivation and behavior within the framework of self-determination theory.

Design: Cross-sectional survey.

Method: 161 Middle school students completed a paper survey which assessed the study variables.

Results: Three sets of models were tested that examined the relationships of autonomy support, involvement, and modeling from mothers, fathers, and physical education teachers to adolescent leisure-time physical activity self-determined motivation and behavior. In the models, each social support variable had a significant, positive, direct relationship to motivation, and a significant, positive, indirect relationship to physical activity behavior mediated by motivation. Further, the relationships between social support from each significant other and motivation were of similar magnitude.

Conclusions: Mothers and fathers both play modest, yet significant roles in their adolescent's leisure-time physical activity motivation. Additionally, physical education teachers, although not present in the leisure-time physical activity context, serve an equally important role in supporting adolescents' leisure-time physical activity. Lastly, adolescent self-determined motivation for leisure-time physical activity is a strong determinant of self-reported leisure-time physical activity behavior.

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Introduction

Adolescence represents a period of rapid personal development and change (Learner & Overton, 2010). As the precursor to adulthood, this age provides the opportunity to teach the value of healthy behaviors, which may consequently support healthier choices throughout life. The adolescent-adulthood link is apparent for various health-related behaviors, such as physical activity participation, where physically active adolescents are more likely to be physically active adults (Hallal, Victora, Azevedo, & Wells, 2006; Menschik, Ahmed, Alexander, & Blum, 2008). To take advantage of the association between adolescent and adult health behaviors, research has focused on variables that support adolescent physical activity. One of these variables is leisure-time physical activity motivation and a theoretical framework that explains the significance of motivation in understanding a wide range of health-

related behaviors is self-determination theory. Self-determination theory is a dialectic, organismic theory that takes into account the relationship between motivation and human behaviors in many contexts, including physical activity (Deci & Ryan, 1985, 1991). For this reason, self-determination theory is well suited for understanding adolescent leisure-time physical activity behaviors (e.g., physical activity completed while not in school).

Self-determination theory distinguishes between intrinsic motivation, extrinsic motivation and amotivation based on their relative level of self-determination or free will (Deci & Ryan, 1985, 1991; Ryan & Deci, 2000). Intrinsic motivation (e.g., "I do leisure-time physical activity because it is fun.") represents the most self-determined form of motivation and behavior is performed for rewards derived from the activity itself. Extrinsic motivation is delineated into four external regulations that are progressively less self-determined in nature and engagement in a behavior is due to reasons outside of the activity. In order from most to least self-determined, they are integrated regulation (e.g., "I do leisure-time physical activity because it complements my view of myself as a fit person"), identified regulation (e.g., "I do leisure-time physical activity because I value it and it will help me get in shape"),

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introjected regulation (e.g., “I run because I will feel guilty if I do not) and external regulation (e.g., “I do leisure-time physical activity so that my mother will not take away my gaming system.”). Separate from intrinsic motivation and the external regulations, amotivation represents a lack of intention or personal drive to act (e.g., “Leisure-time physical activity is not valuable to me and I do not see why I do it.”).

Relatively self-determined regulations (i.e., intrinsic motivation and integrated and identified regulations) are associated with more positive outcomes (Ryan & Deci, 2000). For example, research on adolescent leisure-time physical activity has shown a positive relationship between more self-determined forms of motivation for leisure-time physical activity and self-reported leisure-time physical activity behaviors (Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003). Additionally, using an index of self-determined motivation (e.g., degree of self-determined motivation relative to non-self-determined motivation), relatively self-determined motivation relates positively to leisure-time physical activity behavior (Hagger et al., 2009).

The positive link between self-determined forms of motivation and physical activity behavior is examined and supported in the physical education context as well. In physical education classes, students who are relatively more self-determined in their motivation are more likely to do moderate-to-vigorous physical activity during their free time (e.g., Cox, Smith, & Williams, 2008). Further, students with higher levels of self-determined motivation are shown to take more steps during physical education class than students with lower levels of self-determined motivation (Lonsdale, Sabiston, Raedeke, Ha, & Sum, 2009). Considering the research, physical activity behavior is clearly one consequence of self-determined motivation in leisure-time and physical education settings. In order to understand how to support self-determined motivation it is important to examine its theoretical antecedents. Self-determination theory posits that significant others such as teachers and parents can encourage self-determined motivation through different forms of social support (Ryan & Deci, 2000). One of the most widely examined ways significant others can accomplish this is by providing autonomy support for leisure-time physical activity.

According to Mageau and Vallerand (2003), autonomy supportive significant others value a person's perspectives, acknowledge a person's feelings, and provide pertinent information, and opportunities for choice, while reducing the use of pressures and demands. Specific to the adolescent physical activity context, self-determination theory hypothesizes that autonomy support from significant others, like parents and physical education teachers, encourages feelings of choice and control which supports more self-directed or self-determined motivation (Deci & Ryan, 1985; Ryan & Deci, 2002). Although not often examined within the leisure-time physical activity setting, parent (Hagger et al., 2009) and physical education teacher (Hagger et al., 2007) autonomy support has been positively and directly associated with adolescents' self-determined motivation for leisure-time physical activity.

However, in the only study that has examined both parent and physical education teacher autonomy support in relation to self-determined motivation for leisure-time physical activity, parental autonomy support was considered collectively as opposed to assessing individual perceptions of mother and father autonomy support for leisure-time physical activity (Hagger et al., 2009). In addition, the relationships of parent and physical education teacher autonomy support to self-determined motivation were not compared directly since physical education teacher autonomy support was predicted to relate to leisure-time physical activity motivation through physical education motivation, whereas parent

autonomy support was expected to relate directly to leisure-time physical activity motivation. Research that compares the relative magnitude of physical education teacher, mother and father autonomy support to leisure-time physical activity motivation will provide information about the unique roles that these social agents play in adolescents' leisure-time physical activity.

In addition to autonomy support, other social support variables may help explain variance in adolescent physical activity motivation. For example, involvement of significant others is another form of support consistent with a self-determination theory perspective (Mageau & Vallerand, 2003). Involvement is defined as interest in, knowledge about, time spent relating to and participation with an individual in regards to an activity (Grolnick, Ryan, & Deci, 1991). Parent involvement is expected to support self-determined motivation by encouraging the internalization of motivation resulting in greater endorsement of one's actions (Grolnick, Deci, & Ryan, 1997). In a comprehensive literature review, parent involvement was found to be one of the three most important forms of parent support for leisure-time physical activity (Gustafon & Rhodes, 2006), but has received scant attention within a self-determination theory framework.

In the leisure-time physical activity context, aspects of involvement (i.e., parent facilitation, encouragement, spectatorship, competence beliefs, and participation with their child in regards to leisure-time physical activity) are found to have positive relationships with adolescent leisure-time physical activity (Anderssen & Wold, 1992; Brustad, 1996; Gustafon & Rhodes, 2006; Kimiecik & Horn, 1998; Prochaska, Rodgers, & Sallis, 2002; Sallis, Prochaska, & Taylor, 2000; Springer, Kelder, & Hoelscher, 2006). Teacher involvement in students' leisure-time physical activity has not been examined, though one study did find that perceptions of teacher involvement related to more self-determined motivation in physical education class (Taylor & Ntoumanis, 2007). Consequently, the relative roles of mother, father and teacher involvement in leisure-time physical activity motivation and behavior remain unexamined as well.

Finally, in addition to autonomy support and involvement, perceptions of others' engagement in physical activity or perceived modeling may also serve as a significant type of support related to adolescent leisure-time physical activity motivation, though this potential relationship has not yet been tested. Modeling is generally defined as a significant other's engagement in physical activity and/or sport (Sabiston & Crocker, 2008). The demonstration of physical activity behavior by significant others (i.e., parents and physical education teachers) is expected to attract individuals within the same environment to initiate physical activity behaviors. However, at this time, research on the influence of parent physical activity modeling is inconclusive. In a thorough review by Gustafon and Rhodes (2006) some studies showed a positive relationship, others showed no relationship, and one even showed a negative relationship between the physical activity behavior of parents and their children. Previous studies suggest that this inconsistent relationship may be credited to the deficiency of standardized, validated, and objective measures used in the research (Gustafon & Rhodes, 2006; Sallis et al., 2000). In addition to these limitations, research on the influence of physical education teacher physical activity modeling within the adolescent leisure-time physical activity setting is non-existent and the relationship of parent modeling to self-determined motivation for leisure-time physical activity remains unexamined. Research is needed to improve upon past measures of physical activity modeling and compare the roles of mother, father and physical education modeling to self-determined motivation for leisure-time physical activity.

In summary, research on the associations of perceived mother, father and physical education teacher autonomy support,

involvement, and modeling to adolescent leisure-time physical activity motivation and behavior is either lacking, inconclusive, or non-existent. Thus, the purpose of this study was to explore these relationships within the framework of self-determination theory. Taking into account the previous research, we hypothesized that perceived mother, father and physical education teacher autonomy support, involvement, and modeling will have positive relationships to self-determined leisure-time physical activity motivation (directly) and behavior (indirectly). Further, self-determined motivation for leisure-time physical activity was expected to mediate the relationship between these three social support variables (perceived mother, father and physical education teacher autonomy support, involvement, and modeling) and leisure-time physical activity behavior, supporting self-determination theory. In addition, we examined the relative roles of each mother, father, and physical education teacher support variable in predicting adolescent leisure-time physical activity motivation. There were no specific predictions made with regards to the relative effect of each social support variable on motivation.

Methods

Participants and procedures

After obtaining institutional review board approval, participants were recruited from middle schools (6th–8th grade) from the Midwestern portion of the United States who regularly (e.g., about three times per week) participated in physical education class at their school. Only those students who returned a parental consent form were allowed to participate. Prior to participation, the lead author thoroughly explained the voluntary nature of the study and the confidentiality of the participants' information. Important definitions (e.g., the difference between leisure-time and physical education class physical activity) were also discussed with the students at this time. Students ($N = 162$) then completed a 20–25 min paper survey that assessed each study variable and demographic information. Students ($M_{\text{age}} = 12.77$; range = 10–15 years of age) were 60% female and 90% Caucasian.

Measures

Perceived autonomy support

Three versions of the Perceived Autonomy Support Scale for Exercise Settings (PASSES; Hagger et al., 2007) were used to assess perceived autonomy support for leisure-time physical activity from teachers, mothers, and fathers (12 items per significant other). The original scale measures physical education teacher autonomy support (e.g., "I feel that my PE teacher provides me with choices, options, and opportunities about whether to do active sports and/or vigorous exercise in my free time.") and parent autonomy support (e.g., "I am able to talk to my parent about the active sports and/or vigorous exercise I do in my free time.") for leisure-time physical activity. The physical education teacher items were used in their original form. However, the PASSES was modified to measure mother and father autonomy support for leisure-time physical activity separately. "Parent" was replaced with either mother or father accordingly in order to assess the relative role of these significant others. The participants responded on a 5-point scale ranging from *strongly disagree* (1) to *neutral* (3) to *strongly agree* (5) instead of the original 7-point scale. A 5-point scale was used to be more developmentally appropriate for middle school students and consistent with the other scales included in the survey. The scale has demonstrated adequate internal consistency reliability and construct validity in previous British adolescent

samples for perceptions of physical education teachers and parents (Hagger et al., 2007, 2009).

Perceived involvement

The Perceptions of Parents Scale for Children (POPS; Grolnick et al., 1991) was modified to measure mother, father, and physical education teacher involvement in leisure-time physical activity. To reflect the target physical activities (i.e., sports and/or vigorous exercise) and context (i.e., leisure-time physical activity) the phrases *sports and/or vigorous exercise* and *in my free time* were added to each item. For this study, parent and physical education teacher involvement in children's leisure-time physical activities encompassed interest, knowledge, and time spent relating to and actual participation with the adolescent regarding physical activity. To capture each part of this definition four items were added to the original measure for a total of 9 items. Specifically, items were added to assess frequency of the significant other watching, participating with, and time and effort put into helping the adolescent do leisure-time physical activity. The original measure required participants to read four descriptions and choose which one was most like their mother or father. For this study, an alternative format was chosen to maintain consistency with other scales on the survey and maintain reasonable overall survey length. Participants chose on a four-point scale of *how often* does their mother/father/PE teacher do certain activities (e.g., "How often does your mother/father/PE teacher put time and energy into helping you participate in active sports and/or vigorous exercise during your free time?"). Key words about the frequency of the action were taken from the original response choices and assigned a value on the modified scale. On the modified version, participants answered *always* (4), *sometimes* (3), *usually* (2), or *never* (1) for each item. This scale showed moderate internal consistency in its original form when used with third through sixth grade students (mother involvement $\alpha = .56$; father involvement $\alpha = .64$; Grolnick et al., 1991) and strong internal consistency in a modified version used with adolescent athletes (parental involvement $\alpha = .80$; coach involvement $\alpha = .83$; Gagne, Ryan, & Bargman, 2003).

Perceived modeling

Regarding perceptions of mother, father, and physical education teacher modeling, three items were developed for each target individual. We tried to address past weaknesses in modeling measures as outlined in previous studies (Gustafon & Rhodes, 2006; Sallis et al., 2000) by using three items that assessed perceptions of actual participation of, the frequency of and how often adolescents actually witnessed their mother, father, or physical education teacher doing physical activity. These items read, "My mother/father/PE teacher does active sports and/or vigorous activity regularly", "I see my mother/father/PE teacher participate in sports/exercise", and "My mother/father/PE teacher is physically active on a regular basis". Students answered on a five-point scale ranging from *strongly disagree* (1) to *strongly agree* (5).

Self-determined motivation

Nineteen items were adapted from The Modified Behavioral Regulation in Exercise Questionnaire or BREQ-2 (Markland & Tobin, 2004) to assess motivation for leisure-time physical activity. The participants were given verbal and written instructions to answer these questions about the physical activity they do outside of school. The phrase *in my free time* was added to each item to remind the adolescents of this difference. Also, as with previous scales used in this study, the items were modified to refer to *sports and/or vigorous exercise* as the target physical activities. This scale assesses five motivation regulations ranging from higher to lower levels of autonomy. Four intrinsic motivation (e.g., "I participate in active

sports and/or vigorous exercise in my free time because it is fun”), identified regulation (e.g., “I value the benefits of doing active sports and/or vigorous exercise in my free time.”), introjected regulation (e.g., “I feel guilty when I don’t engage in active sports and/or vigorous exercise in my free time.”), and external regulation items (e.g., “I participate in active sports and/or vigorous exercise in my free time because other people say I should.”), and three amotivation items (e.g., “I think that active sports and/or vigorous exercise is a waste of my time.”) are included on the survey. Participants answered on a five-point scale that ranged from *not true for me* (1), to *sometimes true for me* (3), to *very true for me* (5). The original scale, when used to measure adolescent leisure-time physical activity motivation, has shown satisfactory internal consistency reliability and has demonstrated construct validity (Hagger et al., 2007, 2009). In order to analyze the relationships between social support variables, motivation and physical activity behavior a self-determined motivation composite variable was created by taking the mean of the intrinsic motivation and identified regulation subscales. This composite score was used in all analyses to demonstrate the relationship between more self-determined motivation for leisure-time physical activity and leisure-time physical activity behavior.

Leisure-time physical activity behavior

Leisure-time physical activity behavior was measured using five items from the Physical Activity Questionnaire for Older Children (Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997; Kowalski, Crocker, & Faulkner, 1997). These items assessed physical activity right after school, in the evenings, on the weekend and overall during adolescents’ free time. One item that referred to physical activity throughout the week was modified to include the phrase *in my free time* to specify physical activity outside of school. After these modifications, we took the mean of the five items to represent participants’ leisure-time physical activity behaviors over the last seven days. Students were asked to recall activities like “sports or dance that made them sweat, their legs feel tired, or games that made them breathe hard”. Sports, exercise, working in the yard, doing chores, playing, riding a bike, or walking to school were provided as good examples of physical activity. Items assessed physical activities that occurred at different times after the school day was over (i.e., right after school, during the evenings, or on the weekend). For example, one item read “In the last 7 days, right after school, did you do sports, dance, or play games in which you were very active?” This scale has demonstrated adequate internal consistency for adolescent girls and boys and provided evidence of construct validity in original (Kowalski, Crocker, & Faulkner, 1997; Kowalski, Crocker, & Kowalski, 1997) and shortened forms (Cox et al., 2008).

Data analyses

Preliminary analyses including frequencies, means, standard deviations, correlations, and scale reliabilities were conducted using SPSS 17.0 (SPSS Inc., Chicago, IL). The main analyses were completed in LISREL 8.71 (Scientific Software Inc., Chicago, IL). To maintain a reasonable ratio of participants to number of model parameters (i.e., 10:1; Kline, 2005), we tested three separate sets of models based on type of social support (i.e., autonomy support, involvement, and modeling) using only observed variables. Testing each form of support separately also allowed us to examine relative differences across significant others (i.e., mother, father, physical education teacher) within each type of social support. In all models tested, path analysis using the means of study variables as the observed variables was used. Based on the basic procedures outlined by James, Mulaik, and Brett (2006), the main test of mediation

for each set of social support variables involved comparing the fit of 2 models – a baseline model specifying only indirect effects of the social support variables on leisure-time physical activity through students’ motivation (i.e., the mediation model) and one specifying both direct and indirect effects of social support from each significant other to students’ leisure-time physical activity (i.e., the partial mediation model). The mediation hypothesis is supported if a) social support variables relate significantly to motivation and motivation is a significant predictor of leisure-time physical activity in the mediation model, b) there are significant indirect relationships between social support variables and leisure-time physical activity in the mediation model, c) the direct relationships between social support variables and leisure-time physical activity in the partial mediation model are non-significant, and d) the fit of the partial mediation model is not significantly better than the fit of the mediation model. The principle of parsimony suggests that if the fit of the mediation and partial mediation models are not significantly different, even if some of the direct relationships are significant, the mediation models should be accepted.

Within each set of analyses, examining the different types of support (i.e., autonomy support, involvement, and modeling models), we also tested the relative contributions of mother, father and physical education teachers to adolescents’ physical activity motivation, by comparing the fit of the mediational models to models that constrained the relationships between social support variables and motivation to be equal across mother, father, and physical education teacher. If the constrained model offers a significantly worse fit to the data (based on changes to the chi-squared value), then the relationships of the social support variables to motivation are interpreted as unequal and the unconstrained model is accepted. However, if the fit of the constrained model is not different, this indicates the relationships of the social support variables to motivation are of the same magnitude across significant others and the constrained model will be accepted.

To assess the fit of all models tested, an array of goodness of fit statistics were examined including the Root Mean-Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Standardized Root Mean-Square Residuals (SRMR), and the Goodness of Fit Index (GFI). RMSEA values less than .06 (Hu & Bentler, 1999), CFI values greater than .95 (Byrne, 1998), SRMR values of less than .05 (Byrne, 1998) and GFI values that approach 1.00 (Byrne, 1998) were interpreted as a reflection of a good fit of the model to the data.

Results

Missing data analyses

After visually examining the data prior to running any analyses, one case was removed ($N = 161$), from the study due to an unusually high percentage of missing data (34.9%). Further, inspection of the data revealed that non-response errors would significantly reduce the sample size in the main analyses (by 58 cases). The missing data were scattered across most measures (11/12) and many cases (58/161), with only 1.14% of total data missing. A missing values analysis was deemed necessary to address the substantial decrease in sample size due to a very small percentage of data missing. Little’s MCAR (i.e., missing completely at random) coefficient was non-significant ($p = .408$) indicating that data were missing completely at random. After reviewing this output, three cases were deemed unsuitable for the main analyses because they reported not having a father figure. Any missing data in the remaining cases ($N = 158$) were replaced using values produced from expectation maximization (EM) algorithms. Tabachnick and Fidell (2007) provide a succinct explanation of this two-step procedure.

Preliminary analyses

Descriptive statistics were run for each study variable and the means, standard deviations, scale reliabilities, and correlations are included in Table 1. On average, the respondents perceived moderate to high levels of autonomy support and low to moderate levels of involvement from mothers, fathers, and physical education teachers. Perceived modeling was moderate to high across significant others. In addition, students had high levels of self-determined motivation for leisure-time physical activity, and were fairly active in their free time. Each scale exceeded the .70 criterion for internal consistency reliability and the bivariate correlations reflected mostly weak to moderate, positive relationships among the study variables.

Main analyses

Standardized values for multivariate skewness (12.06, 5.52, 3.99) and kurtosis (5.73, 3.33, -.56) were calculated for the autonomy support, involvement, and modeling models respectively. The skewness values were significant ($p < .01$) for each model and the kurtosis values were significant ($p < .01$) for the autonomy support and involvement models. In order to compensate for the significant values, maximum likelihood estimation was used due to its robustness to non-normal data (Hu & Bentler, 1999).

The first social support variable examined was perceived autonomy support from mothers, fathers, and physical education teachers. In the mediation model, perceived autonomy support from mothers (.19, $p < .05$) and teachers (.16, $p < .05$) predicted self-determined motivation and motivation (.60, $p < .01$) predicted leisure-time physical activity. In addition, the indirect relationships from mother (.11, $p < .05$) and teacher (.10, $p < .05$) autonomy support to physical activity were significant. In the partial mediation model, none of the direct relationships between autonomy support variables and physical activity were significant. Finally, the fit of the partial mediation model ($df = 0$, $\chi^2 = .00$, “the fit was perfect”) was not significantly ($p > .05$) better than the fit of the mediation model ($df = 3$, $\chi^2 = 6.11$; RMSEA = .0; CFI = 1.00; SRMR = .02; GFI = 1.00). Therefore, the mediation model was accepted. A comparison of this mediation model to one constraining the relationships of autonomy support from each significant other to self-determined motivation to be of equal magnitude yielded no significant differences in model fit ($\Delta df = 2$, $\Delta \chi^2 = .19$, $p > .05$). Therefore, the constrained model was accepted as the final model (Fig. 1) which indicates that these relationships were not significantly different in magnitude (even though autonomy support from father was not significant in the original mediation

model). The final model accounted for 13% of the variance in self-determined motivation and 36% of the variance in leisure-time physical activity.

Next, models were tested that included perceived involvement from mothers, fathers, and physical education teachers. Perceived involvement from mothers (.27, $p < .01$) predicted motivation and motivation (.60, $p < .01$) predicted physical activity in the mediation model. Further, the indirect relationship from mother involvement to physical activity was significant (.16, $p < .01$). In the partial mediation model, teacher involvement predicted physical activity directly (.13, $p < .05$), however, the fit of this model ($df = 0$, $\chi^2 = .00$, “the fit was perfect”) was not significantly ($p > .05$) better than the mediation model ($df = 3$, $\chi^2 = 6.11$; RMSEA = .08; CFI = .98; SRMR = .05; GFI = .98). Therefore, the mediation model was again accepted based on the principle of parsimony. A comparison of this mediation model to one constraining the relationships of involvement from each significant other to self-determined motivation to be of equal magnitude again showed no significant differences in model fit ($\Delta df = 2$, $\Delta \chi^2 = 3.86$, $p > .05$). Consequently, the constrained model was accepted as the final model and indicates that these relationships were not significantly different in magnitude. The final model accounted for 7% of the variance in self-determined motivation and 36% of the variance in leisure-time physical activity.

Finally, the relationships among perceived mother, father, and physical education teacher modeling, self-determined motivation, and leisure-time physical activity motivation were considered. In the mediation model, teacher modeling (.19, $p < .05$) predicted motivation and motivation (.60, $p < .01$) predicted physical activity. The indirect relationship between teacher modeling and physical activity was also significant (.12, $p < .05$). In the partial mediation model, none of the direct relationships between the three modeling variables and physical activity were significant. As with the previous two, the fit of the partial mediation model ($df = 0$, $\chi^2 = .00$, “the fit was perfect”) was not significantly different than the mediation model ($df = 3$, $\chi^2 = 4.34$; RMSEA = .05; CFI = .99; SRMR = .04; GFI = .99). Therefore, the mediation model was accepted. As with the previous models, the constrained model was tested and accepted as the final model because the fit ($\Delta df = 2$, $\Delta \chi^2 = 1.76$, $p > .05$) was not significantly different from the mediation model. Once again, relationships of mother, father, and physical education teacher modeling to self-determined motivation did not differ significantly in magnitude. The final model explained 7% of the variance in self-determined motivation and 36% of the variance in leisure-time physical activity. Figs. 1–3 show the standardized path coefficients for each of the final constrained models and Table 2 displays the strength of the indirect relationships in these models.

Table 1

Means, standard deviations, correlations, and Cronbach's alpha coefficients.

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. AS (mother)	4.16	.87	.94										
2. AS (father)	4.26	.94	.60**	.96									
3. AS (PE teacher)	3.24	1.03	.27**	.22**	.93								
4. INV (mother)	2.77	.61	.48**	.34**	.20*	.81							
5. INV (father)	2.93	.69	.24**	.53**	.19*	.51**	.88						
6. INV (PE teacher)	1.92	.75	.18*	.17*	.68**	.16	.25**	.92					
7. MDL (mother)	3.80	1.31	.39**	.24**	-.01	.35**	.11	.00	.92				
8. MDL (father)	3.11	1.34	.20*	.37**	.18*	.19*	.43**	.20*	.43**	.93			
9. MDL (PE teacher)	3.80	1.20	.14	.13	.51**	.20*	.05	.31**	.05	.13	.81		
10. LTPA SDM	4.10	.84	.29**	.23**	.23**	.32**	.17*	.13	.20*	.15	.23**	.89	
11. LTPA	3.29	1.03	.17*	.18*	.19*	.22**	.22**	.24**	.16*	.22**	.22**	.60**	.91

Notes. Cronbach's alpha coefficients are arranged along the diagonal in boldface. All variables are perceptions. $N = 161$. AS = autonomy support; INV = involvement; MDL = modeling; LTPA = leisure-time physical activity; SDM = self-determined motivation.

* $p < .05$. ** $p < .01$.

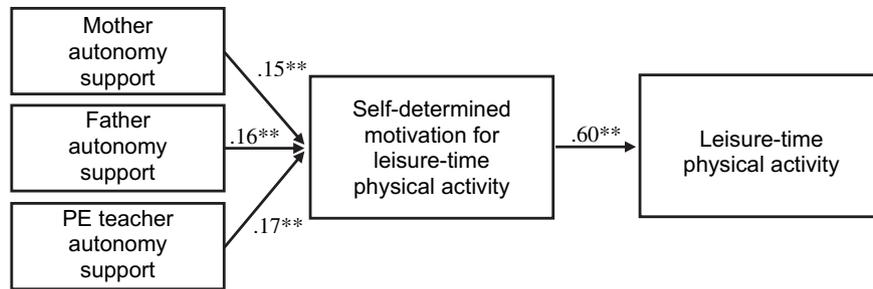


Fig. 1. Social agent autonomy support mediation model including standardized path coefficients. All variables are measures of perceptions. PE = physical education. * $p < .05$. ** $p < .01$.

Discussion

The purpose of this study was to explore the relationships of mother, father, and physical education teacher autonomy support, involvement and modeling to adolescent self-determined motivation and behavior in the leisure-time physical activity context. Social support variables were hypothesized to have a positive relationship to self-determined motivation for leisure-time physical activity. This hypothesis was supported through the small but significant, positive relationships of all nine social support variables to self-determined motivation in the multivariate analyses. In each of the three final models, 13%, 7% and 7% of the variance in self-determined motivation for leisure-time physical activity was accounted for by parental and physical education teacher autonomy support, involvement and modeling respectively. These small magnitudes are not unusual. Previous studies (Chatzisarantis & Hagger, 2009; Hagger et al., 2009) that measured the relationship between perceived parent autonomy support and a relative autonomy index of motivation found paths of similar magnitude ($\beta = .20, p < .01$; $\beta = .19, p < .01$, respectively) in British samples. Results also supported the hypothesized, mediating role of significant others' support and physical activity behavior. Further, self-determined motivation had a moderately strong, positive relationship to actual physical activity behavior. Overall, our models accounted for 36% of the variance in adolescent leisure-time physical activity behavior while similar studies (Chatzisarantis & Hagger, 2009; Hagger et al., 2009) have accounted for 60.4% and 53.2% of the variance in physical activity behavior. However, these other two studies included additional variables (i.e., behavioral intention and/or attitude, subjective norm, and perceived behavioral control) as mediators between motivation and leisure-time physical activity behavior and had larger samples ($N = 215$ and $N = 404$, respectively).

This study expands upon research on the role of parents and teachers in adolescents' physical activity behavior in several ways.

Although research has been abundant on the role of parents in their child's leisure-time physical activity behavior, it has often been descriptive in nature and has lacked tests of specific theoretical propositions (Gustafon & Rhodes, 2006; Sallis et al., 2000). Couching the role of parents within the self-determination theory perspective allowed for testing the mediating role of self-determined motivation. Testing this specific theoretical premise assists in understanding the pathways by which parent support may influence children's actual leisure-time physical activity behavior. Self-determination theory posits that various forms of social support should have a positive relationship to behavior to the extent that they foster self-determined forms of motivation (Deci & Ryan, 1985, 1991).

Past research on the role of parents in leisure-time physical activity using aspects of self-determination theory has largely focused on the role of perceived parent autonomy support (Hagger, Chatzisarantis, Barkoukis, Wang, & Baranowski, 2005; Hagger et al., 2009). This study expanded upon this research by measuring both mother and father autonomy support individually and including additional forms of parent support (i.e., involvement and modeling). Mother and father social support variables were moderately correlated to one another (autonomy support $r = .60$, involvement $r = .51$, modeling $r = .43, p < .05$) indicating that while there is some degree of correspondence between students' perceptions of support from their mothers and fathers, students differentiate between the amount of support they perceive from their mothers and fathers. All forms of support related positively to adolescent leisure-time physical activity through self-determined motivation. Thus, this study illustrates multiple pathways through which parents may be able to positively influence their children to be physically active in their free time. Though, it should be noted that these relationships were quite modest in magnitude indicating that other factors contribute substantially to children's internalization of physical activity motivation.

In addition to parental support, this study explored the link between physical education teacher support and adolescent

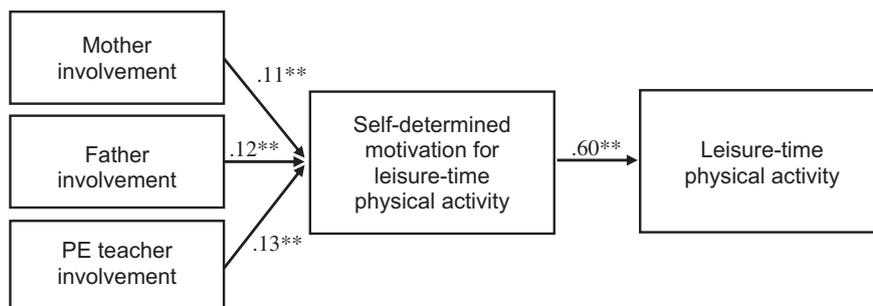


Fig. 2. Social agent involvement mediation model including standardized path coefficients. All variables are measures of perceptions. PE = physical education. * $p < .05$. ** $p < .01$.

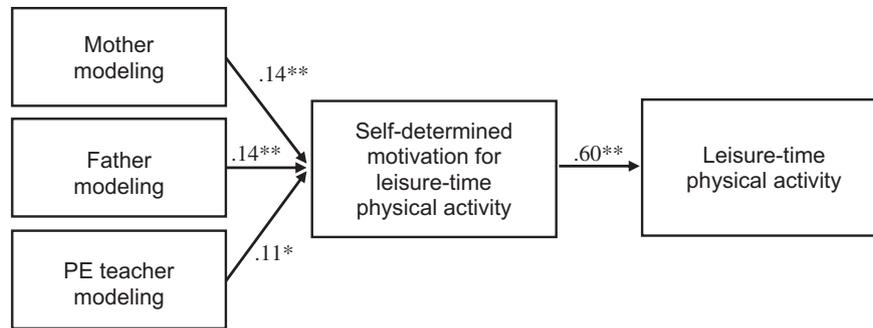


Fig. 3. Social agent modeling mediation model including standardized path coefficients. All variables are measures of perceptions. PE = physical education. * $p < .05$. ** $p < .01$.

leisure-time physical activity. Up until this time, no study has examined multiple physical education teacher support variables in the leisure-time physical activity context, using self-determination theory. The findings reinforce previous studies that draw attention to the role of physical education teacher autonomy support in the classroom (Hagger et al., 2003, 2005, 2009) and is the first study to reveal the importance of physical education teacher involvement and modeling in adolescent leisure-time physical activity motivation. Students' perceptions of their teachers' involvement and physical activity behaviors appear to relate to their own physical activity behaviors through more self-determined forms of motivation. While often discussed (e.g., McKenzie, 2007), these physical educator findings provide empirical support for the link between the physical education class and leisure-time physical activity contexts (Hagger et al., 2003, 2007, 2009).

Another important contribution this study makes to the literature on the roles of significant others to self-determined motivation and leisure-time physical activity behavior is the comparison of multiple significant others within different types of social support (Chatzisarantis & Hagger, 2009; Hagger et al., 2003, 2005, 2007, 2009). In each of the final three models, the relationships between each significant other support variable (i.e., mother, father, physical education teacher) and self-determined motivation were not significantly different in magnitude as evidenced by a good fit to the data in the constrained models. These results suggest that mothers, fathers, and physical education teachers make equal contributions to adolescents' leisure-time physical activity motivation and behavior. Intuitively, it would seem that parents should have a stronger influence over adolescent leisure-time physical activity due to their greater presence in this context. This study does not support this suspicion. Our study, along with previous

studies, suggests that physical educators have the potential to bridge the connection between physical education class and actual physical activity behavior outside of school (Hagger et al., 2009) and are of equal importance to parents in supporting free-time physical activity.

Although the intention of many studies is to understand how to support adolescent physical activity behavior, physical activity is often unmeasured or inadequately measured (Hagger, 2010). In the current study, adolescent leisure-time physical activity behavior was assessed using a previously validated and reliable 7-day recall measure, therefore addressing this common omission and concern. Future studies utilizing objective measures of physical activity such as steps taken in and out of physical education class (Lonsdale et al., 2009), may further demonstrate the link between physical education class and leisure-time physical activity contexts.

While this study illustrated the relative roles of multiple social variables in the leisure-time physical activity context, it also has its limitations. The current study was cross-sectional in design and its results should be interpreted as such. Study variables were only measured once, which illustrates relationships but should not be interpreted in a causal manner. A longitudinal study that tracks adolescents' perceptions of social support variables, motivation, and behavior over time would supplement this research by showing how changes in motivation and behavior relate to social support variables over time. It may also illustrate the roles that mothers, fathers, and physical education teachers play in the internalization of leisure-time physical activity behaviors. A related point is that this study hypothesized, based on self-determination theory, that significant others influence adolescents' behavior and did not consider the reverse, that adolescent behavior may influence significant others' support. We did not take into account the potential recursive effect of adolescent physical activity behavior on significant others' social support which may also be tested through the use of a longitudinal design. Lastly, testing potential moderating variables such as ethnicity, gender, socioeconomic status and child gender (Gustafon & Rhodes, 2006; Sallis et al., 2000) may help provide valuable information for those designing interventions for certain groups of adolescents.

There is also ample opportunity for future research to continue testing additional tenets of self-determination theory in the leisure-time physical activity context. For example, future studies may want to examine the role of psychological need satisfaction (i.e., competence, autonomy, and relatedness perceptions) in the relationship between social support variables and leisure-time physical activity motivation and behavior (Barkoukis, Hagger, Lambropoulos, & Torbatzoudis, 2010). Barkoukis and colleagues have conducted the only study at this time to have done so. These authors found that in the leisure-time physical activity context only students perceptions of competence ($\beta = .17, p < .05$) and relatedness ($\beta = .19, p < .05$) had significant effects on autonomous

Table 2
Standardized indirect effects of social factors.

Relationship	Path coefficient
AS (mother) to LTPA	.09**
AS (father) to LTPA	.10*
AS (PE teacher) to LTPA	.11**
INV (mother) to LTPA	.07**
INV (father) to LTPA	.07**
INV (PE teacher) to LTPA	.08**
MDL (mother) to LTPA	.08**
MDL (father) to LTPA	.08**
MDL (PE teacher) to LTPA	.06**

Notes. All variables are perceptions. $N = 158$, AS = autonomy support; INV = involvement; MDL = modeling; LTPA = leisure-time physical activity; SDM = self-determined motivation; Each indirect effect is calculated as a product of the standardized path from the social support variable to self-determined motivation and the standardized path from motivation to leisure-time physical activity. The significance of each indirect effect is determined by the Sobel (1982) test.

* $p < .05$. ** $p < .01$.

motivation. However this study only tested physical education teacher autonomy support in their model. Future studies may expand upon these findings by including additional forms of social support (e.g., involvement, modeling) from different social agents (e.g., parents, peers) in conjunction with psychological need satisfaction. Doing so may demonstrate the avenues (i.e., competence autonomy and relatedness) through which specific types of social support relate to self-determined motivation while testing additional facets of self-determination theory. Also, future studies could compare the relative roles of different types of social support from significant others instead of the relative roles of significant others across type of social support as we did in this study. With this intention, such studies may help distinguish the relative contribution of each type of social support and, as a result, expand the current adolescent leisure-time physical activity research.

This study provides some straightforward applications to parents or those working as physical educators who desire to support adolescents' leisure-time physical activity motivation and behavior. For example, mothers, fathers and physical educators should recognize their role in promoting adolescents' perceptions of autonomy by providing opportunities for choice, and considering and supporting adolescents' opinions and decisions about their leisure-time physical activity. Significant others could enhance perceptions of involvement by simply participating with, or taking the time to watch the adolescent do physical activity. Lastly, mothers, fathers, and physical education teachers should be aware that perceptions of their own physical activity might be a predictor of adolescents' physical activity behavior and should demonstrate or discuss their physical activity habits to encourage their child or student to be active as well. All in all, mothers, fathers, and physical education teachers can help their adolescent become physically active in the short-term using adaptive support (i.e., autonomy support, involvement and modeling) to encourage a more self-determined motivation for leisure-time physical activity behavior which is linked to actual physical activity behavior and adherence in the long term.

Appendix. Supplementary data

Supplementary data associated with this article can be found, in the online, version at doi:10.1016/j.psychsport.2011.10.003.

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