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Exploring Self-Perceptions and Social Influences as Correlates of Adolescent Leisure-Time Physical Activity

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This study examined adolescent leisure-time physical activity correlates using the expectancy-value (EV) model. Adolescents (*N* = 857) completed questionnaires to assess competence and value self-perceptions, social influences, and physical activity. Direct and indirect effects of self-perceptions and parent and best friend influences on physical activity were explored using structural equation modeling. Measurement models were a good fit to the data and gender invariance was supported. The structural mediation model was a reasonable fit to the data, whereby the indirect effects of parents and peers and the direct effects of competence beliefs and values together accounted for 49% of the variance in physical activity. In this model, the pattern of relationships was similar for adolescent males and females. Findings supporting the EV model provide theoretical and practical implications for understanding adolescent physical activity.

Keywords: expectancy-value model, competence beliefs, subjective value, role-modeled behavior, emotional support

Several participation motivation models identify key factors influencing physical activity engagement. Based on these perspectives, perceptions of competence, enjoyment and interest, and the beliefs and behaviors of significant others are important correlates of adolescent physical activity (see Sallis, Prochaska, & Taylor, 2000; Weiss & Williams, 2004). However, there is limited evidence of the simultaneous effects of these factors. The expectancy-value (EV) model (Eccles, 1983) provides a framework to examine these coexisting relationships. In the EV model, an individual's behavior is directly a function of her or his context-specific personal efficacy expectations and subjective values (Eccles, 1983; Eccles & Wigfield, 1995; Wigfield et al., 1997). According to Eccles and Wigfield (2002), personal efficacy expectations are indiscernible from competence beliefs among children and adolescents. Therefore, a factor comprised of personal efficacy expectations and competence beliefs combines with subjective value to predict youth behavior. Subjective value is multidimensional (Eccles & Wigfield, 2002) and includes interest value (the enjoyment an individual gains from engaging in a behavior), attainment value (the importance of doing well and engaging in a behavior), utility value (the usefulness of a task or behavior to one's sense of self and future goals), and relative costs (the negative components of engaging in a behavior, including financial, time, opportunity, and effort costs).

The EV model has been used primarily as a framework to examine academic achievement behaviors, yet there is growing evidence that the model provides useful perspectives to understand youth sport and physical activity. For instance, competence beliefs, plus utility and importance values, were significantly related to time spent by adolescents in sport (Eccles & Harold, 1991). The EV model was partially supported in competitive high school sports, where personal efficacy expectations (but not attainment value) emerged as a significant correlate of effort and persistence (Cox & Whaley, 2004). Finally, competence beliefs and interest value were identified as important correlates of children's leisure activity (i.e., Dempsey, Kimiecik, & Horn, 1993; Kimiecik, Horn, & Shurin, 1996; Kimiecik & Horn, 1998). Although many of the integral relationships have been explored, there is limited evidence of model testing. Also, key links among self-perceptions, social relationships, and behavior have not yet been examined. A unique set of EV model relationships that has not been evaluated includes the proposition that perceptions of significant others' beliefs and behaviors play a primary role in youths' development of competence beliefs and values.

Based on the EV model, the methods of parent and peer influence have been broadly defined as role-modeled behavior, emotional support and encouragement, and others' beliefs (Eccles, 1983; Fredricks & Eccles, 2005). Role modeling has often been explored as significant others' engagement in physical activity and/or sport. Research exploring the association between role-modeled behavior and youth physical activity has yielded inconclusive results (Kimiecik et al., 1996; Sallis, Prochaska, & Taylor, 2000; Voorhees et al., 2005). The ambiguous findings might be due to the narrowly defined operationalization of the construct to be engagement only, rather than the communication of beliefs and values. Significant others' beliefs have been restrictively explored with youth sport and physical activity, where values such as importance and usefulness are inconsistently associated with behavior (Eccles & Harold, 1991; Kimiecik & Horn, 1998). Unfortunately, there is no similar research focused on adolescents and leisure physical activity. Lastly, significant others are proposed to influence youths' perceptions and behaviors through emotional support such as reinforcement and encouragement (Brustad, 1996; Kimiecik et al., 1996; Raudsepp, 2006; Welk, Wood, & Morss, 2003). According to the EV model, significant others' role-modeled behavior, emotional support, and beliefs may impact adolescents' perceptions of competence and values, which in turn influence physical activity. The nature of these relationships remains elusive.

Many motivation studies have examined the influence of parents on their children's behavior (Brustad, 1996; Fredricks & Eccles, 2005; Kimiecik & Horn, 1998; Prochaska, Rodgers, & Sallis, 2002; Welk et al., 2003). Parent encouragement and support has emerged as the most important mechanism influencing youth physical activity and sport behavior (Ornelas, Perreira, & Ayala, 2007; Prochaska et al., 2002; Stuart, 2003; Trost et al., 2003). Based on a review of parental correlates of youth physical activity, Gustafson and Rhodes (2006) suggest that reported associations between child and parent activity may be mediated by differences in parental support and encouragement, with role modeling having little impact. In fact, the importance of parental role-modeled behavior is consistently attenuated when other mechanisms of influence are observed (Brustad, 1996; Dempsey et al., 1993; Trost et al., 2003); and there is some evidence of no association to youth behavior (Anderssen, Wold, & Torsheim, 2006). Research with adolescent samples is much less prevalent.

Peers also influence adolescent self-perceptions and behaviors, and may play a more prominent role in relation to parents (Beets, Vogel, Forlaw, Pitetti, & Cardinal, 2006; Harter, 1999). In particular, close friends (i.e., best friends) may be more influential than peer groups and social crowds in academic and physical domains (Berndt & Keefe, 1995; Weiss & Stuntz, 2004). Despite some advancement in this area (see Smith, 2003; Weiss & Stuntz, 2004), the literature exploring role-modeled behavior, emotional support, and peer beliefs as mechanisms of influence on adolescent physical activity perceptions and behavior is limited. It has been reported that adolescent girls who have more physically active friends report greater activity (Voorhees et al., 2005) and that adaptive peer relationship profiles among youth are associated with greater perceptions of sport competence and enjoyment (Smith, Ullrich-French, Walker, & Hurley, 2006). Even though more evidence with close friends is necessary, Smith (2003) has also suggested focusing on combined peer relationships and other social influences in physical activity contexts. Understanding both peer and parent influences on adolescents' physical activity is warranted because there is limited evidence examining both parent and peer influences (Smith, 2003; Ullrich-French & Smith, 2006). The EV model provides a framework to explore these relationships.

Whereas the EV model suggests that significant other influences on physical activity behavior are mediated by perceptions of competence and values, there are competing empirical approaches proposing more direct relationships. Welk and colleagues (2003) supported a model whereby parental influence indirectly affected children's attraction to physical activity (conceptually similar to value) and perceptions of competence, and had a direct effect on children's physical activity behavior. Similarly, Trost et al. (2003) proposed a model directly linking parent physical activity and indirectly linking parent support to children's physical activity (a relationship mediated by child self-efficacy). However, findings from their study revealed no significant direct association between parent and child physical activity, and an additional significant relationship emerged between parental support and child physical activity. Additional models exploring direct effects of parent and peer support on youth physical activity have also been tested (i.e., Beets et al., 2006; Prochaska et al., 2002). These studies found a lack of conclusive evidence for parent and peer direct effects. Some of the inconclusive findings may be attributed to the mediating role of competence beliefs and values. Thus, comparisons between the EV model of mediated effects and an alternate direct effects model is warranted to further understand the nature of significant other influences on adolescent physical activity.

It is also important to test the structural relationships in the EV model for gender differences. However, differences in the relationships among perceptions of competence, value, significant other influences, and adolescent physical activity behavior for adolescent males and females are not likely to emerge. There is support for invariance in measures used to capture self-perceptions and behavior (Crocker et al., 2000), and there is little evidence that gender moderates the relationships (Eccles & Harold, 1991; Crocker et al., 2000). Also, mean-level differences on the main EV model constructs should be explored. Limited evidence suggests males receive more parental support for physical activity than females, yet report similar parental role modeling (Gustafson & Rhodes, 2006). Additionally, consistent empirical findings reveal that males are more likely to engage and spend more time participating in sport and physical activity, and exert more effort, compared with females (Sallis et al., 2000; Weiss & Williams, 2004). Also, males place higher importance and/or feel more competent in sport-type domains than females (Crocker, Eklund, & Kowalski, 2000; Sallis et al., 2000). Gender differences on peer influences need to be examined, and differences on all EV model constructs should be explored among older adolescent males and females.

The general purpose of this study was to examine the structural relationships among older adolescent's self-perceptions, social influences, and physical activity. A secondary purpose was examining gender differences in latent means and structural relationships among these constructs. Based on theoretical assumptions and empirical findings, it was hypothesized that (a) perceptions of competence and value would be correlates of physical activity; (b) perceptions of best friend and parent beliefs, role-modeled behavior, and emotional support would be correlates of competence beliefs and values; (c) perceptions of competence and value would mediate the effects of parent and best friend influences on physical activity; and (d) adolescent males would report higher competence beliefs, values, social influences, and physical activity behavior compared with females; however, there would be no significant gender differences in the structural relationships in the EV model.

Methods

Participants and Procedures

Behavioral research ethics board approvals from the university and secondary school districts in Vancouver, British Columbia, Canada, were obtained. Approval from six (27% of those contacted) school administrators was granted. Following presentations introducing the study to Grade 10 through 12 classes, information packages for parents and students were distributed. A minimum of 7 days later, students between the ages of 15 and 18 years who had provided consent ($N = 902$, 57.1% response rate) participated by completing an in-class survey.

Measures

Participant Characteristics. For descriptive purposes, physical characteristics were assessed by reported height (meters) and weight (kilograms), which were used to calculate body mass index (BMI = kg/m^2). Adolescents were also asked to identify their age and ethnicity.

Perceptions of Competence. Perceptions of competence were assessed as general ability beliefs and personal efficacy expectations for physical activity. Ability beliefs were assessed by a modified version of the Perceived Competence Scale for Exercising Regularly (Williams, Ryan, & Deci, 2004). This measure was modified in two ways: *exercising regularly* was substituted with "participating in regular physical activity" and the response anchor was modified to reflect how often participants felt confident in their abilities to participate in regular physical activity rather than how true the statement was to them. These modifications were suggested by J. Eccles (personal communication, January 11, 2004) during a review of the instrument for content validity, and were supported by R. Ryan (personal communication, January 20, 2004). An example of an item from the four-item scale is, "I feel capable of participating in regular physical activity," responded on a 7-point Likert scale ranging from 1 = *none of the time* to 7 = *all of the time*.

Personal efficacy expectations were assessed with three items developed for this study based on recommendations from J. Eccles (personal communication, January 11, 2004). The items were, "I expect to have the skills necessary to participate in regular physical activity," "I expect to be good at participating in regular physical activity," and "I am able to learn new skills necessary to participate in regular physical activity." These items were also responded to on 7-point Likert scales ranging from 1 = *none of the time* to 7 = *all of the time*. To test the EV model, ability beliefs and personal efficacy expectations were indicators of a latent variable called *perceptions of competence*. This method has been supported elsewhere (Fredricks & Eccles, 2005).

Subjective Values. Interest, attainment, and utility values were assessed using the Self- and Task-Perception Questionnaire (Eccles & Wigfield, 1995; Wigfield et al., 1997). The six items were modified to represent physical activity behaviors rather than the physical education-based sport items on the original scale. The modifications were made to reflect the leisure-time nature of the behavior rather than the academic achievement focus in the original items. Examples of subjective value items include the following: interest—"In general, I find participating in physical activity" (1 = *very boring* to 7 = *interesting*); attainment—"For me, being able to participate in regular physical activity is" (1 = *not at all important* to 7 = *very important*); and utility—"I find participating in physical activity" (1 = *not at all valuable* to 7 = *very valuable*). Although distinctions among values can be made at the conceptual level, it has been suggested that a good fit to the overall EV model is to construct a latent variable that is analogous to a global subjective value construct (Fredricks & Eccles, 2005; Eccles, personal communication, April 24, 2005). For this study, interest, attainment, and utility values were identified as indicators of a subjective value latent factor.

Cost values were measured using items developed with consideration of the construct meaning and were based on suggestions from J. Eccles (personal communication, October 8, 2003). The items represented time, financial, opportunity losses, and physical discomfort constraints associated with physical activity. An example of a financial cost item was, "Participating in regular physical activity requires how much of your own money?" (1 = *none of my own money* to 7 = *a lot of my own money*). Costs items were assessed on 7-point Likert scales.

Perceptions of Significant Others' Influences. The adolescents' perceptions of parent and best friend beliefs, role-modeled behavior, and emotional support were assessed with existing measures (Fredricks & Eccles, 2005). Sport-focused items targeting parents were modified to reflect the physical activity context, and comparable items were used to explore best friend influences. The items were also modified to tap adolescents' perceptions of these influences rather than objective responses from parents and peers. For this study, *parent/guardian* was defined as the mother/female guardian or father/male guardian with whom the adolescent spends the most time with outside of school and *best friend* was defined as the peer they spend the most time with at and/or away from school. The items were answered on 7-point Likert scales, and there were two items for role-modeled behavior (e.g., "how often does your [best friend/parent or guardian] participate in regular physical activity?"; 1 = *not at all* to 7 = *very often*), four items for beliefs (e.g., "to your [best friend/parent or guardian], how important is participating in regular physical activity?"; 1 = *not at all important* to 7 = *very important*), and two items for emotional support (e.g., "how often does your [best friend/parent or guardian] encourage you to participate in regular physical activity"; 1 = *not at all* to 7 = *very often*). In the main analyses, the three methods of influence were identified as indicators of global best friend and parent influence latent factors. This combined approach is supported in previous work (i.e., Welk et al., 2003).

Physical Activity Behavior. Physical activity was assessed using the Leisure-Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1985). The first item on the scale (PA1) assessed the quantity of weekly strenuous, moderate, and light activity that occurred outside of regular physical education classes. A total score was calculated by multiplying the weekly frequencies of strenuous, moderate, and light activities by 9, 5, and 3, respectively, for a total metabolic-equivalent intensity value. The second item on the scale (PA2) asked for the frequency of regular activity (1 = *often* to 3 = *never/rarely*) in a typical 7-day period that results in a fast heartbeat and sweating. This item has emerged as a strong predictor of aerobic fitness during construct validity tests (Godin & Shephard, 1985), and there is support for the use of this measure with adolescents (Sallis, Buono, Roby, Mickle, & Nelson, 1993).

Physical activity was also assessed using a reliable and valid two-item moderate-to-vigorous physical activity (PA3) measure (Prochaska, Sallis, & Long, 2001). The items assessed frequency of 60 min or more of moderate-to-vigorous physical activity in the past 7 days as well as in a typical week. An average score was calculated to determine a subscale score for activity. In the main analyses, the LTEQ measures and this subscale were identified as indicators of a physical activity latent factor.

Owing to the modified instruments, a pilot study was conducted with an older adolescent sample ($N = 68$). The findings revealed adequate internal consistencies for perceptions of competence ($\alpha = .94$); personal efficacy expectations ($\alpha = .83$); subjective values of interest, attainment, and utility ($\alpha = .78–.92$); and parent and best friend role-modeled behavior ($\alpha = .86$ and .85), beliefs ($\alpha = .86$ and .88), and emotional support ($\alpha = .84$ and .77). A copy of the instrument can be obtained from the first author.

Data Analysis

Means, standard deviations, and Pearson correlations for all manifest variables were examined using SPSS 13.0. The adequacy of the EV model was tested using the maximum likelihood estimation method of structural equation modeling with the

LISREL 8.71 program (Joreskög & Sorböm, 2004). To test the main hypotheses related to the EV model, the data were analyzed in four main steps: (1) the measurement model was tested using confirmatory factor analysis (Byrne, 1998); (2) multigroup analysis of factorial and latent mean structure invariance was tested for adolescent males and females using a stepwise procedure (Byrne, 1998; Vandenberg & Lance, 2000); (3) effects of parent and best friend influences, perceptions of competence, and values on adolescent physical activity were tested using path modeling to compare the EV model (competence beliefs and value mediating the influence of parent and best friend on physical activity) and an alternate model (direct effects of parent and peer influences on physical activity) to explore competing theoretical assumptions (Holmbeck, 1997); and (4) gender differences in the relationships among constructs in the best-fitting model determined in (3) were explored using structural invariance.

For all analyses, adequate model fit was determined using several indices (Hu & Bentler, 1999): (a) comparative fit index (CFI; values approximating .95); (b) non-normed fit index (NNFI; values approximating .95); and (c) root mean square error of approximation (RMSEA; values approximating .05). Because chi-square values can become complicated with sample size and non-normal distributions, these values were not used to make decisions about model fit (Byrne, 1998). Chi-square was used to determine significant differences between competing models. Specifically, a significant chi-square change value, with respect to the change in degrees of freedom, illustrates that one model is a better fit to the data. In all analyses, critical values of $t \geq 1.96$ and/or $p \leq .05$ were used to determine statistical significance.

Results

Descriptive Statistics

Data were screened for accuracy and assumptions. Forty-five individuals were excluded from further analyses owing to missing descriptive data ($n = 27$) and not meeting the study age restrictions of 15–18 years ($n = 18$). The final sample consisted of 438 girls and 419 boys (*M* age = 16.32, *SD* = .94), who self-described as primarily Caucasian (54.5%) and Asian (24.9%) and reported mean BMIs of 21.68 kg/m^2 (males) and 21.17 kg/m^2 (females).

The data were relatively multivariate normal (Mardia's coefficient = 1.12 for adolescent males and 1.16 for females). The normalized kurtosis values were 9.42 and 12.32, respectively. Examining the instrument properties, all measures had acceptable internal consistencies ($\alpha = .76$–$.94$), except cost value ($\alpha = .46$). Cost value was excluded from all analyses. Means and standard deviations and correlations for the study variables are presented in Table 1.

Main Analyses

Confirmatory Factor Analyses. The mediation measurement model was specified where the indicators were uniquely loaded on appropriate factors, the variance of each latent factor was fixed to 1.00 for identification, factors were allowed to correlate, and the uniquenesses (measurement error associated with the observed

Table 1 Correlation Coefficients for Adolescent Males (n = 419; top) and Females (n = 438; bottom), and Means and Standard Deviations (*SD*) for Significant Other Influences, Perceptions of Competence, Values, and Physical Activity

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. PA1	—	.53*	.49*	.33*	.35*	.20*	.24*	.20*	.16*	.15*	.18*	.09	.08	.04
2. PA2	.62*	—	.55*	.43*	.41*	.37*	.36*	.39*	.21*	.20*	.23*	.14*	.14*	.05
3. PA3	.62*	.62*	—	.57*	.56*	.45*	.46*	.47*	.30*	.32*	.31*	.27*	.23*	.17*
4. AB	.44*	.51*	.56*	—	.87*	.62*	.63*	.64*	.28*	.26*	.30*	.31*	.25*	.13*
5. PE	.42*	.49*	.50*	.89*	—	.61*	.63*	.62*	.23*	.26*	.26*	.32*	.26*	.13*
6. IN	.35*	.44*	.44*	.62*	.57*	—	.68*	.67*	.31*	.30*	.33*	.35*	.27*	.13*
7. AT	.32*	.46*	.40*	.62*	.56*	.73*	—	.80*	.30*	.34*	.33*	.41*	.35*	.17*
8. UT	.37*	.52*	.47*	.64*	.61*	.71*	.76*	—	.29*	.35*	.31*	.43*	.41*	.20*
9. BES	.28*	.31*	.37*	.39*	.37*	.36*	.36*	.39*	—	.77*	.62*	.22*	.18*	.19*
10. BB	.23*	.23*	.28*	.34*	.32*	.27*	.34*	.35*	.79*	—	.75*	.27*	.28*	.21*
11. BRM	.24*	.21*	.29*	.32*	.31*	.29*	.30*	.33*	.68*	.80*	—	.27*	.27*	.20*
12. PES	.20*	.33*	.26*	.31*	.30*	.32*	.34*	.36*	.35*	.25*	.25*	—	.74*	.41*
13. PB	.21*	.30*	.25*	.30*	.33*	.26*	.31*	.36*	.33*	.33*	.28*	.74*	—	.52*
14. PRM	.05	.10*	.08	.17*	.18*	.16*	.16*	.15*	.20*	.23*	.20*	.42*	.53*	—
Males	61.61	2.42	3.54	21.90	16.48	11.58	11.22	11.21	7.63	14.84	9.91	10.55	18.49	7.68
	(30.58)	(.60)	(1.78)	(4.80)	(3.44)	(2.53)	(2.53)	(2.69)	(3.76)	(6.05)	(3.07)	(3.16)	(5.74)	(3.17)
Females	48.55	2.11	2.90	19.35	14.64	10.42	10.81	10.69	7.64	14.72	8.72	10.65	19.58	8.16
	(29.42)	(.71)	(1.93)	(5.86)	(4.19)	(3.11)	(2.82)	(2.94)	(3.80)	(6.51)	(3.65)	(3.47)	(6.02)	(3.50)

Note. PA1= physical activity in METS; PA2= physical activity frequency; PA3= moderate-to-vigorous physical activity; AB = ability beliefs; PE = personal efficacy expectations; IN = interest value; AT = attainment value; UT = utility value; BES = best friend emotional support; BP = best friend beliefs; BRM = best friend role modeled behavior; PES = parent emotional support; PB = parent beliefs; PRM = parent role modeled behavior. All constructs, with the exception of PA2, are composite scores.

*$p < .05$.

variables) were not allowed to correlate. As revealed in Table 2, the factor loadings were all relatively high and significant (93% greater than .60), with low standard errors (<.05). The uniquenesses demonstrated moderate random error in the ability of the EV items to assess the latent constructs. The correlations among EV latent factors were moderate (see Table 2). Fit statistics show good fitting measurement models for the total sample, females, and males (see Table 3, Model 1a-1c).

Group Invariance. To test invariance across the measurement models for males and females, equality constraints (or restrictions) were set for the factor structure, loadings, variances, and covariances, and residuals in successive models (Byrne, 1998; Vandenberg & Lance, 2000). Invariance was evaluated by a chi-square difference test between nested models, in addition to RMSEA, CFI, and NNFI fit indices (Byrne, 1998). Results revealed significant chi-square difference tests between Models 2b through 2e (Table 3); however, the fit indices of the various nested models were nearly identical to the baseline model. There were no significant changes in model fit for the equivalency of factor structure and loadings (Table 3, Model 2a and 2b). A nonsignificant test of invariant factor loadings, coupled with minimal change in fit indices, is an adequate observation to demonstrate a nondifference in simultaneous group analyses (Dishman, Motl, Saunders, et al., 2002; Marsh, Hey, Johnson, & Perry, 1997). Therefore, findings support factorial equivalency of the measurement model.

Invariance of Latent Means. To explore latent mean differences for adolescent males and females, it was necessary to specify a model with invariant factor loadings and invariant item intercepts across groups, and to fix the factor intercepts of one group (adolescent females) to zero (Byrne, 1998). Although a test of invariant item intercepts is not of substantive interest, an adequately fitting model is necessary to accurately interpret the latent mean estimates (Byrne, 1998). As shown in Table 3 (Model 3), the invariant factor loading and intercept model was acceptable based on the fit statistics. Differences in latent factor means were identified by examining the kappa matrix in the LISREL output, which shows parameter estimates, standard errors, and *t* values for the latent means of the male group in comparison with the female group. In addition to reporting the *t* values, standardized effect sizes were calculated using the following equation from sample data: $d = |\kappa_1 - \kappa_2| / \phi^{1/2}$, where $\kappa_1 - \kappa_2$ are sample latent variable means for each group and ϕ is a within-groups pooled variance estimate for latent variable scores. A value for ϕ was determined by $\phi = \{[(n_1 \times \phi_1) + (n_2 \times \phi_2)]/(n_1 + n_2)\}$, where ϕ_1 and ϕ_2 are estimated variances from the latent variables, and n_1 and n_2 are the group sample sizes (Hancock, 2001). With two groups and the use of reliable instruments, these effect sizes can be interpreted based on social science guidelines of $d = .2$, .5, and .8 equating to small, medium, and large effect sizes, respectively (Hancock, 2001). Adolescent males had significantly higher perceptions of competence ($t = 7.17$, $d = .50$), subjective value ($t = 3.57$, $d = .23$), and physical activity ($t = 6.92$, $d = .54$) and lower parent influence ($t = -2.29$, $d = .17$) compared with females. There were no differences in the latent means for best friend influence ($t = 1.79$, $d = .13$). These results supported the hypothesis of gender differences for all factors with the exception of best friend influence.

Path Models. The adolescent male and female samples were pooled to test the structural models. In the path analysis, the first loading of each congeneric

Table 2 Standardized Factor Loadings and Uniquenesses for the Expectancy-Value Latent Factors, and Correlations Among the Latent Factors in the Measurement Models for the Total Sample, and Separately for Adolescent Females and Males

Latent factors and indicators	Factor loadings	Uniqueness	Correlations PA	PC	SV	Best friend	Parent
		Total sample (*N* = 857)					
Physical activity			—	.69	.62	.37	.28
PA1	.71	.50					
PA2	.78	.39					
PA3	.81	.34					
Perceptions of competence				—	.75	.36	.31
AB	.97	.07					
PE	.92	.16					
Subjective value					—	.43	.43
IN	.81	.35					
AT	.87	.24					
UT	.88	.22					
Best friend						—	.35
BES	.82	.33					
BB	.95	.10					
BRM	.80	.35					
Parent							—
PES	.80	.35					
PB	.92	.16					
PRM	.56	.58					
		Females (*n* = 438)					
Physical activity			—	.66	.63	.37	.35
PA1	.75	.44					
PA2	.80	.36					
PA3	.81	.35					
Perceptions of competence				—	.75	.39	.35
AB	.98	.24					
PE	.91	.18					
Subjective value					—	.43	.41
IN	.83	.31					
AT	.87	.25					
UT	.87	.24					
Best friend						—	.38
BES	.95	.11					
BB	.83	.30					
BRM	.84	.30					
Parent							—
PES	.80	.36					
PB	.93	.13					
PRM	.56	.58					

(continued)

Table 2 *(continued)*

Latent factors and indicators	Factor loadings	Uniqueness	Correlations PA	PC	SV	Best friend	Parent
		Males (n = 419)					
Physical activity			—	.69	.59	.37	.28
PA1	.61	.63					
PA2	.70	.51					
PA3	.83	.31					
Perceptions of competence				—	.77	.30	.33
AB	.94	.11					
PE	.91	.14					
Subjective value					—	.42	.49
IN	.77	.40					
AT	.89	.21					
UT	.89	.20					
Best friend						—	.33
BES	.96	.09					
BB	.80	.36					
BRM	.78	.39					
Parent							—
PES	.87	.33					
PB	.90	.19					
PRM	.55	.69					

Note. PA1 = physical activity in METS; PA2 = physical activity frequency; PA3= moderate-to-vigorous physical activity; AB = ability beliefs; PE = personal efficacy expectations; IN = interest value; AT = attainment value; UT = utility value; BES = best friend emotional support; BP = best friend beliefs; BRM = best friend role modeled behavior; PES = parent emotional support; PB = parent beliefs; PRM = parent role modeled behavior. All coefficients are significant, $p < .05$.

set of measures was set to 1.0 for identification, and the parent–best friend and competence beliefs–value latent factors were free to correlate. Two conceptual latent path models were examined to compare a mediation model and a competing direct effects model. The direct effects model (see Figure 1) was tested in which best friend and parent influences, in addition to perceptions of competence and subjective value, were hypothesized to relate to physical activity directly. Goodness-of-fit statistics revealed an adequate structural model (see Table 3, Model 4a). This model accounted for 50% of the variance in adolescent physical activity. The significance of the direct and indirect effects were identified by examining the gamma (direct) and indirect effects matrices in the LISREL output. These matrices show the parameter estimates, standard errors, and t values for the relationships among endogenous and exogenous latent variables. The relative contribution of the direct and indirect effects can be calculated using the following formula: Percentage (%) of indirect (or direct) effects = (indirect (or direct) effects/total effects) × 100, where total effects = indirect + direct effects. As shown in Table 4, best friend influences on physical activity were primarily indirect effects, (.27/.38) × 100 =

Table 3 Goodness-of-Fit Statistics for Measurement, Group Invariance, and Structural Models

Models	χ^2	*df*	RMSEA	CFI	NNFI
Model 1—Measurement Model					
Total Sample	250.85	69	.055	.98	.97
Females	160.95	69	.055	.98	.97
Males	148.72	69	.053	.98	.97
Model 2—Group invariance					
2a. Baseline	295.05	134	.053	.98	.97
2b. FL	320.30	143	.054	.98	.97
2c. FL+FV	342.78*	148	.055	.97	.97
2d. FL+FV+FC	363.07*	158	.055	.97	.97
2e. FL+FV+FC+U	412.14*	172	.058	.97	.97
Model 3—Latent means					
3. FL+II+LM	423.94	152	.065	.97	.96
Model 4—Structural models					
4a. Direct effects model	243.69	67	.056	.98	.97
4b. Mediation model	250.85	69	.055	.98	.97
Model 5—Structural invariance					
5a. Baseline	333.83	144	.056	.98	.97
5b. Equal paths	341.80	150	.055	.97	.97

Note. RMSEA = root mean square error of approximation; CFI = confirmatory fit index; NNFI = non-normed fit index; FL = factor loadings; FV = factor variances; FC = factor covariances; U = uniquenesses; II = item intercepts; LM = latent means.

*$p < .05$: chi-square difference between nested models.

71%, with significant direct effects also emerging in the model. Only the indirect effects of parent influences on physical activity were significant, accounting for more than 94%, (.17/.18) × 100, of the total effects.

The mediation model (see Figure 2) was tested in which best friend and parent influences were hypothesized to relate to physical activity indirectly through perceptions of competence and values. Fit statistics suggested this model was a good fit to the data (Table 3, Model 4b) and accounted for 49% of the variance in activity. The direct and indirect effects are presented in Table 4.

The competing models were compared. The direct effects model was a statistically significantly better fitting model compared with the mediation model based on the chi-square difference ($\Delta\chi^2 = 7.16$) for 2 *df*. A closer look at the evidence, however, suggests that there is little gained by allowing the direct relationships between parent and best friend influences and physical activity. The evidence consists of the stable fit indices, insubstantial change in R^2 moving from the direct model ($R^2 = .50$) to the mediation model ($R^2 = .49$), the path from parent to physical activity emerging as nonsignificant, and the path from best friend to physical activity being relatively weak. Furthermore, the decomposition of effects did not provide substantial support for direct effects. Therefore, the mediation model is

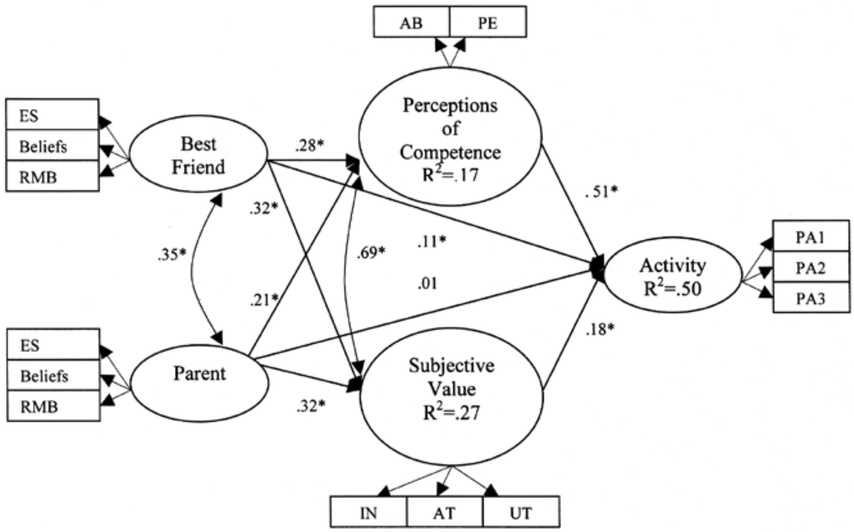

Figure 1 — Direct effects model depicting the standardized solution for the direct effects of best friend and parent influences, perceptions of competence, and subjective value on physical activity for adolescents.

Table 4 Direct and Indirect Effects of Best Friend and Parent Influences, Perceptions of Competence (PC), and Subjective Value (SV) on Physical Activity

	Unstandardized parameter estimates (standard error)		Standardized parameter estimate	
Model	Indirect effects	Direct effects	Indirect effects	Direct effects
Direct model				
Best friend	1.35 (.22)*	.38 (.13)*	.27*	.11*
Parent	.73 (.10)*	.06 (.29)	.17*	.01
PC	—	2.08 (.23)*	—	.51*
SV	—	1.66 (.54)*	—	.18*
Mediation model				
Best friend	.80 (.10)*	—	.22*	—
Parent	1.48 (.23)*	—	.18*	—
PC	—	2.08 (.23)*	—	.51*
SV	—	2.14 (.50)*	—	.23*

*$t \leq 1.96$.

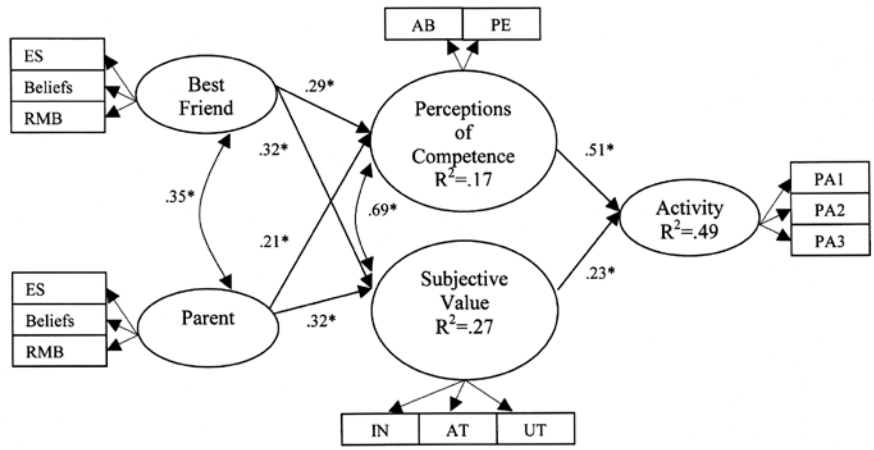

Figure 2 — Mediation model depicting the standardized solution for the best friend and parent influences as indirect effects of physical activity and perceptions of competence and subjective value as direct effects of physical activity for adolescents.

deemed an appropriate fit to the data based on model parsimony and conceptual considerations. Based on this model and in support of three main study hypotheses: (a) perceptions of competence and value were correlates of physical activity, (b) perceptions of best friend and parent influences were correlates of competence beliefs and values, (c) perceptions of competence and value mediated the effects of parent and best friend influences on physical activity.

Structural Group Invariance. A final test was conducted to explore significant gender differences on path coefficients in the mediation model. The baseline model (Table 3, Model 5a) shows all paths free to be estimated for both genders. This model was compared with a fully constrained model in which all paths were set equal (Table 3, Model 5b). Based on the chi-square difference ($\Delta\chi^2 = 7.97$) for 6 *df*, the paths were not significantly different for adolescent males and females. These findings defend the hypothesis of no gender differences in the model relationships and provide further support for the EV model.[1]

Discussion

This research explored the applicability of the EV model in understanding physical activity in older adolescents. The findings of good-fitting measurement and structural models, coupled with the 49% of accounted variance in adolescent physical activity exemplify the utility of the EV model. Consistent with the conceptual framework, competence beliefs and values were strong correlates of physical activity, and both parent and best friend influences were significant sources of competence beliefs and value. The significant indirect effects of best friend and parent influences on physical activity and the strong support for gender invariance in the measurement and structural models further support the EV tenets. This study is one of the first to confirm the salient relationships of the EV model with physical activity in older adolescents.

Based on the EV model, the main purpose of this study explored perceptions of competence and values as mediators of the relationship between best friend and parent influences and adolescent physical activity behavior. The benefit of this study over others with similar objectives (i.e., Beets et al., 2006; Prochaska et al., 2002; Trost et al., 2003; Welk et al., 2003) is the model testing of competing theoretical perspectives. With this approach, it was clear that mediation was supported and the EV model is a logical framework in which to study adolescent physical activity. Furthermore, the findings provide evidence that physical activity perceptions of competence and value are both integral to understanding adolescent physical activity and should be included in conceptual models of participation motivation. This finding is consistent with EV research targeting youth participation in sport and physical activity (Brustad, 1996; Eccles & Harold, 1991; Dempsey et al., 1993; Kimiecik et al., 1996). Finally, the results support developmental perspectives associated with behavioral influences (Harter, 1999; Horn, 2004). Specifically, parents continue to act as sources of physical activity self-perceptions and behavior into older adolescence but play a smaller role compared with peers. This is evident in the small significant direct effect of best friend on physical activity. However, it is clear that the key correlates of behavior are self-perceptions of competence and value.

Perceptions of parent and best friend influences were hypothesized correlates of competence beliefs and values. The final model revealed that these influences combined to account for 17% of the variance in perceptions of competence. This finding supports the growing body of literature exploring sources of competence beliefs (i.e., Harter, 1999; Horn, 2004; Weiss & Amorose, 2005) while extending the evidence to an older adolescent sample. Both parent and best friend influences were also sources of physical activity values, accounting for 27% of the variance. There is limited evidence of the sources of subjective values in sport and physical activity. Stuart (2003) found that social influences were key factors associated with multiple dimensions of youth sport values. Stuart reported that among youth who reported low sport values, significant other behaviors (role modeling) were linked to interest and attainment values whereas peer and parent beliefs were associated with the usefulness of sport. Encouragement (support) from significant others was also associated with high sport values among youth. Using a person-centered approach, Smith and colleagues (2006) reported that adaptive peer relationship profiles among early adolescent sport participants were associated with greater perceptions of sport enjoyment and competence beliefs. Little is known of the associations between significant other influences and older adolescent's physical activity values. The current study suggests parent and best friend influences should continue to be explored as sources of adolescent physical activity values. As such, the EV model provides a framework to test sources of values and perceptions of competence and can guide further research and intervention strategies in this area. The practical application of these findings needs to be explored, as well as examining teachers, siblings, and significant others as additional sources of beliefs, role-modeled behavior, and emotional support for adolescent physical activity behavior.

In support of the hypothesis for mean-gender differences, adolescent males reported greater perceptions of competence, value, and physical activity. Boys consistently report greater perceptions of competence, are more interested in and enjoy physical activity, and more frequently engage in activity compared with girls (Crocker et al., 2000; Fredricks & Eccles, 2005; Sallis et al., 2000). Common reasons for these gender differences include such propositions as (a) parent/guardian stereotypes support the traditional notion that males *should* be better at sports and physical activity (Fredricks & Eccles, 2005); (b) continued societal valence placed on the masculine nature of sport and physical activity (Eccles, Barber, Jozefowicz, Malanchuk, & Vida, 1999; Trost et al., 2003); and (c) strong theoretical links between sport competence, sport skills, and male self-esteem (Eccles et al., 1999; Harter, 1999). Based on the EV model and current findings, males were more likely to be physically active because they have enhanced perceptions of competence and value compared with females. Contrary to the hypothesis, males reported significantly less parental influence compared with females, and there were no gender differences on reporting of best friend influences. Even though there is generally limited evidence of gender differences pertaining to best friend influences on adolescent physical activity, research has both supported (Brustad, 1996; Kimiecik & Horn, 1998; Raudsepp, 2006) and contradicted (Gustafson & Rhodes, 2006; Trost et al., 2003) the finding of greater parental influence among females. Most of this evidence has been with younger children and early adolescents, and has involved actual parental reports instead of adolescent perceptions of parental influences. The EV tenets suggest that adolescents' perceptions of significant other influences are integral to their physical activity behavior; thus, more research is needed to explore differences in these perceptions for adolescent males and females. Nonetheless, it is generally understood that parental influences are important for enhancing youth physical activity. Some researchers have also suggested that parental physical activity support is particularly relevant for girls (Fogelholm, Nuutinen, Pasanen, Myohanen, & Saatela, 1999) and that girls may be more responsive to parental influences (Ornelas et al., 2007). The higher perceptions of parental influence reported by females in the current study may be confirming this latter point with an older adolescent sample. It is important to note that higher perceptions of parental influence were not reflected in females' higher self-perceptions or behaviors. Likewise, lower perceptions of parental influence for males did not appear to influence their self-perceptions or behavior. More research is warranted to understand gender differences on perceptions of social influences. The EV model suggests the adolescent's cultural milieu (i.e., gender role stereotypes, cultural stereotypes, and family demographics) and significant others' own beliefs and behaviors need to be explored to understand the reported gender differences (Eccles, 1983; Eccles et al., 1999; Eccles & Wigfield, 2002). These propositions require further research, and longitudinal designs would enable the exploration of when and why these gender differences emerge.

In spite of the mean-level gender differences that emerged in this study, there were no differences in the proposed structural relationships. This is an important observation implying that parent and peer influences similarly impact adolescent male and female perceptions of competence and values, which in turn similarly affect their physical activity. Thus, intervention strategies targeting adolescent physical activity should focus on these main constituents. Separate interventions for males and females would be most practical provided the mean-level gender differences, but similar strategies could (and should) be implemented. Unfortunately, most studies to date have either not explored gender differences in the relationships among social influences, self-perceptions, and physical activity or have only partially tested the proposition. Thus it is recommended that future studies test the significance of relationship differences for males and females so that intervention strategies can be appropriately tailored.

The findings from this study must be considered within the context of inherent limitations. With the cross-sectional nature of the study, there is an inability to determine causal links and direction of relationships. The results here support only the initial directions proposed in the EV model, yet reciprocal effects are possible and should be explored using longitudinal designs. For example, Crocker, Sabiston, Kowalski, McDonough, and Kowalski (2006) recently reported reciprocal effects between physical competence perceptions and physical activity levels in a 3-year longitudinal study of adolescent girls. Furthermore, the current study sampled adolescents from classes at various schools and it is appropriate to acknowledge the possible clustering of responses that have not been accounted for in the current analyses. An additional limitation of this study is the inability to adequately measure cost value, which has been reported elsewhere (Cox & Whaley, 2004; Eccles & Wigfield, 2002). It is clear that the construct is multidimensional, and improving the assessment of costs would include exploring additional items for each of the dimensions of time, effort, financial, and effort/difficulty. The developmental period of adolescence is at the cusp of independence, and the costs associated with behavior may be more informative than at any other time. Unfortunately, the conceptualization and measurement of cost value is still in its infancy, and requires rigorous testing and implementation to accurately examine the possible effects on the EV model.

In spite of the limitations, the results provide support for the EV model tenets and advance the literature on correlates of leisure physical activity among older adolescents—a population often ignored in studies of this kind (Sallis et al., 2000). The findings from this study, coupled with supporting recommendations from the field, suggest that the effectiveness of intervention programs should be maximized when adolescents (a) report competence in their ability to engage in physical activity, (b) enjoy the behaviors they have chosen and find them personally important and useful, and (c) perceptions of competence and value would be enhanced by maximizing encouragement and support from parents and peers.

Note

1. Given the recent emphasis on the combined effects of parent and peer influences (Smith, 2003; Ullrich-French & Smith, 2006), interaction effects were also examined. Because the EV model does not necessarily suggest interactive effects, it was not a main hypothesis in this study. Interactive effects were explored for males and females separately (using group-mean-centered data) and as a combined sample (grand-mean-centered data). Interactions were explored using hierarchical regression analyses following guidelines provided by Jaccard & Turrisi (2003). The analyses included exploring the interaction of best friend and parent beliefs, emotional support,

and role-modeled behavior on (a) competence beliefs, (b) subjective value, and (c) physical activity. In all analyses, the second steps in the regressions were not significant, and none of the interaction terms significantly accounted for additional variance of competence beliefs, values, or physical activity.

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