

Examining Social–Cognitive Determinants of Intention and Physical Activity Among Black and White Adolescent Girls Using Structural Equation Modeling

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Structural equation modeling was used to evaluate components within the theories of reasoned action (TRA), planned behavior (TPB), and self-efficacy (SET) for understanding moderate and vigorous physical activity among 1,797 Black and White adolescent girls. Modest to strong support was provided for components of TPB and SET; weak support was provided for components of TRA. Perceived behavioral control was related to vigorous physical activity. Self-efficacy was related to moderate and vigorous physical activity, and it accounted for the effect of intention on physical activity. The observed relationships were similar between Black and White girls. Self-efficacy and perceived behavioral control are independent influences on physical activity among Black and White adolescent girls and warrant study as potential mediators in physical activity interventions.

Key words: attitude, expectation, perceived behavioral control, race, self-efficacy, social norm

Physical inactivity is prevalent among adolescent girls in the United States, especially among African American girls (Centers for Disease Control and Prevention, 1998), and is presumed to be a burden to public health (Sallis & Patrick, 1994). The prevalence of physical inactivity among adolescent girls underscores the need for developing interventions to increase physical activity (Sallis et al. 1992). Identification of social–cognitive variables that correlate with physical activity represents one approach that can inform such interventions (Baranowski, Anderson, & Carmack, 1998; Dishman, 1991). Social–cognitive variables, which include personal beliefs that are sensitive to reinforcement history and social influence, are putative influences on volitional behavior. Therefore, social–cognitive variables warrant study as potential influences on physical activity among adolescent girls, particularly because physical activity increasingly becomes a leisure choice as American youth enter adolescence.

Three well-established theories of social–cognitive variables derived from expectancy–value and social learning theories (Ban-

dura, 1977; Edwards, 1954; Feather, 1982; Rotter, 1960) have been used to explain physical activity among adults (Hausenblas, Carron, & Mack, 1997) and may be informative for understanding and changing physical activity among youth. These theories are reasoned action (TRA; Fishbein & Ajzen, 1975), planned behavior (TPB; Ajzen, 1985, 1991), and self-efficacy (SET; Bandura, 1977, 1986, 1997). The theoretical models are depicted in Figure 1.

Only a small number of studies have used TRA, TPB, and SET to investigate correlates of physical activity among youth. The existing research partially supports components of TRA and TPB as correlates of intention and physical activity (e.g., Craig, Goldberg, & Dietz, 1996; Godin & Shephard, 1986; Greenockle, Lee, & Lomax, 1990; Hagger, Chatzisarantis, & Biddle, 2001; Hagger, Chatzisarantis, Biddle, & Orbell, 2001; Mummery, Spence, & Hudec, 2000). Self-efficacy has been associated with physical activity in about half of the studies that examined children and youth (Sallis, Prochaska, & Taylor, 2000).

To our knowledge, researchers have not directly tested the independence and primacy of the TRA, TPB, and SET for understanding physical activity among Black and White adolescent girls. There are theoretical and practical reasons why it is important to do so. Theory guides intervention, so it is important to identify which of the theoretically based relationships hold up in explaining variation in physical activity among adolescent girls. For example, does intention to be physically active mediate the effects of attitude, subjective norm, and perceived behavioral control on physical activity among adolescent girls? Do perceived behavioral control and self-efficacy directly affect physical activity among adolescent girls? Direct tests of these theoretically based relationships are needed to permit empirically based judgements about the use of TRA, TPB, and SET as guides for interventions imple-

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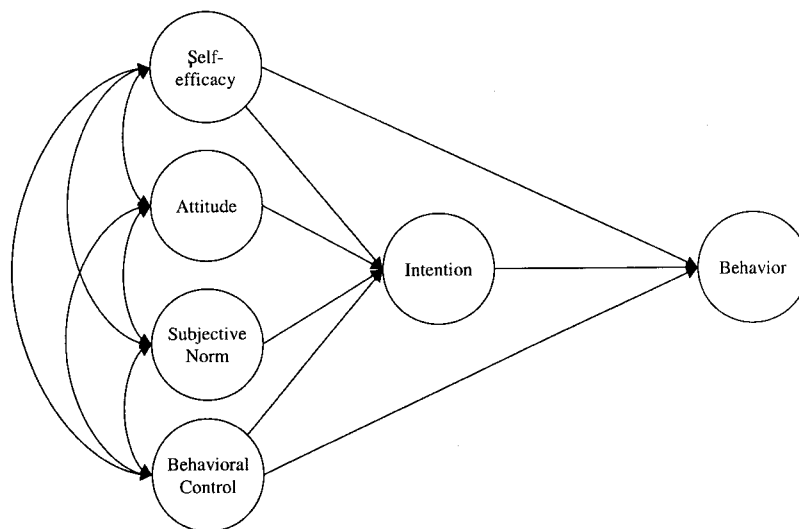


Figure 1. Model depicting the components of the theories of reasoned action, planned behavior, and self-efficacy in relationship to behavior.

mented to increase leisure time physical activity among adolescent girls.

We also are unaware of studies that have examined the possible interrelationships and specificity of components within TRA, TPB, and SET for understanding physical activity among Black and White adolescent girls. For example, the relationships among self-efficacy, intention, and physical activity require examination because the link between intention and physical activity might be attributable to third-variable influences (Dishman, 1994; Godin, 1994). Though self-efficacy has been shown to exert such a third-variable influence on the relationship between intention and physical activity among college students (Dzewaltowski, Noble, & Shaw, 1990), we are unaware of studies that have tested whether self-efficacy accounts for the relationship between intention and physical activity among adolescent girls.

The relationships among perceived behavioral control, self-efficacy, and physical activity also require examination, because perceived behavioral control might be redundant with self-efficacy in explaining variation in health behaviors (Bandura, 1997). Such redundancy was not observed for physical activity among college-aged students (Dzewaltowski et al., 1990, p. 398), but the effect of perceived behavioral control on intention was attenuated by self-efficacy among adolescent boys and girls (Hagger, Chatzisarantis, & Biddle, 2001). Any apparent redundancy between self-efficacy and perceived behavioral control might be the result of measurement artifact. Measures of perceived behavioral control often have reflected beliefs about personal capability rather than task difficulty (e.g., Mummery et al., 2000). Hence, perceived behavioral control and self-efficacy, when measured as perceived difficulty and perceived capability (Bandura, 1997), may not be redundant in explaining physical activity.

It is also theoretically and practically important to examine whether the components of TRA, TPB, and SET are related differently with moderate versus vigorous physical activity. SET explicitly posits that self-efficacy determines the intensity of behavior (Bandura, 1997). Hence, self-efficacy should be related to both moderate and vigorous physical activity in the presence of

incentives. Moderate and vigorous physical activity are believed to confer different health and fitness benefits (Bouchard, 2001) and may be associated differently with social-cognitive variables (Dishman, 1994; Sallis et al., 1992). Thus, interventions might need to target different theoretically based social-cognitive variables to alter moderate or vigorous physical activity.

TRA, TPB, and SET traditionally have been examined using bivariate correlation and multiple regression analyses on observed variables. This analytic approach is not optimal. Structural equation modeling (SEM) with latent variables has advantages over the traditional analytical approach. SEM allows for simultaneous estimation and testing of theoretically based relationships among multiple predictor, intervening, and outcome latent variables as depicted in Figure 1. Moreover, the magnitude of the parameter estimates between latent variables are independent of all other latent variables in the model and are not biased by measurement error. Another advantage of SEM involves an analysis of multi-group invariance. This analysis enables a direct comparison of theoretically based relationships among latent variables between groups.

Some additional issues with past studies also require resolution to clarify the usefulness of TRA, TPB, and SET for application with adolescent girls. Valid measures of physical activity and psychological constructs have not been used in many studies (Dishman, 1982, 1994). Also, some studies have used questions that appear to measure the individual's expectation (i.e., probability or likelihood) rather than intention (i.e., conscious plan) to be physically active (Courneya & McAuley, 1993; Warshaw & Davis, 1985). Intention and expectation may be related differently to physical activity (Hausenblas et al., 1997) and components of TRA and TPB (Courneya & McAuley, 1993) as well as SET. We are unaware of studies that have tested these possibilities among adolescent girls.

The present study used SEM to further evaluate the utility of TRA, TPB, and SET for understanding physical activity in Black and White adolescent girls. The SEM tested the theoretically based relationships of self-efficacy, attitude, subjective norm, and behav-

ioral control to intention and expectation and the relationships of self-efficacy, behavioral control, intention, and expectation to moderate and vigorous physical activity. Therefore, the SEM facilitated a direct test of the independence, primacy, and interrelationships of constructs within TRA, TPB, and SET for explaining two levels of physical activity among Black and White adolescent girls. We performed secondary analyses testing the invariance of the structural model between Black and White adolescent girls to determine whether the constructs and relationships were similar across race.

Method

Participants

Participants were adolescent girls in the eighth grade from 24 middle schools in South Carolina. The middle schools were randomly selected from 54 of the 214 schools within the 91 school districts of South Carolina that were eligible and willing to participate in a school-based intervention to increase physical activity and fitness. Eligibility was based on two criteria: (a) number of eighth-grade girls per school and (b) an approximately equal mix of Black and White girls in the school. There were 4,044 girls enrolled in the 24 middle schools, and 44.4% of the girls volunteered to participate ($N = 1,797$). The girls had a mean age of 13.57 years ($SD = 0.63$), mass of 60.25 kg ($SD = 16.22$), height of 161.11 cm ($SD = 6.73$), and body mass index of 23.07 kg/m² ($SD = 5.48$). The racial proportions were 49.9% Black, 45.8% White, and 3.6% other (Native American, Asian/Pacific Islanders, and Latina/Hispanic); 0.7% of the girls did not report race. The procedures were approved by an institutional review board, and participants and the parent or legal guardian provided written informed consent. Participants completed the baseline measures in groups of 6 to 10 girls in the spring of 1999; only the baseline data from the intervention were analyzed in the present report.

Measures

We have described the development and psychometric properties of the measures of attitude, subjective norm, perceived behavior control, and self-efficacy about physical activity in earlier studies (Dishman et al., 2002; Motl et al., 2000). The measures used in the current study all conformed to unidimensional models that were invariant across groups and time. The measure of attitude included eight items that consisted of belief

and corresponding value statements. Belief statements were rated on a 5-point scale anchored by 1 (*Disagree a lot*) and 5 (*Agree a lot*). Value statements were rated on a 5-point scale with responses ranging from 1 (*Very bad*) to 5 (*Very good*). The attitude items were formed as a product of the belief and corresponding value item scores (Ajzen, 1991). The measure of subjective norm included eight items that consisted of normative beliefs and corresponding motivation-to-comply statements. The items were rated on a 5-point scale anchored by 1 (*Disagree a lot*) and 5 (*Agree a lot*). The subjective norm items were formed as the product of the normative belief and motivation-to-comply item scores (Ajzen, 1991). The measure of perceived behavioral control included four items. Three items were rated on a 5-point scale with anchors of 1 (*Agree a lot*) and 5 (*Disagree a lot*). One item was rated on a 5-point scale with anchors of 1 (*Very easy*) and 5 (*Very difficult*). We reverse scored the items such that higher scores reflect greater levels of perceived behavioral control. The measure of self-efficacy consisted of eight items rated on a 5-point scale ranging from 1 (*Disagree a lot*) to 5 (*Agree a lot*). Example items are presented in Table 1.

The measures of intention and expectation included four and three items, respectively. The items were rated on a 5-point scale with anchors of 1 (*Disagree a lot*) and 5 (*Agree a lot*). The items were developed as suggested by Courneya and McAuley (1993) and Warshaw and Davis (1985) and modified after an evaluation by a focus group of eighth-grade girls. The intention items were (a) "I *intend* to be physically active during my free time on most days," (b) "I *will* be physically active during my free time on most days," (c) "I *plan* to be physically active during my free time on most days," and (d) "I *am going* to be physically active during my free time on most days." The expectation items were (a) "I *expect* to be physically active during my free time on most days," (b) "I'm *pretty sure* I will be physically active during my free time on most days," and (c) "There's a *good chance* I'll be physically active during my free time on most days" (italics added). The measures of intention and expectation have not been tested for factorial validity or multigroup invariance. Hence, the factorial validity and invariance of unidimensional models to these measures were established based on the results of the covariance modeling.

Physical activity was assessed using the 3-Day Physical Activity Recall (3DPAR), which is a modification of the Previous Day Physical Activity Recall (Weston, Petosa, & Pate, 1997). We selected the 3DPAR because it assesses multiple days of physical activity in a single reporting session, and it is well suited for school-based investigations where student access is limited to one or two class periods. Moreover, assessing physical activity over multiple days provides a reliable estimate of "usual" physical activity.

Table 1
Sample Items From the Questionnaires Measuring the Latent Variables of Attitude, Subjective Norm, Perceived Behavioral Control, and Self-Efficacy

Questionnaire	Sample Items
Attitude	If I were to be physically active during my free time on most days it would help me make new friends. If I were to be physically active during my free time on most days it would be fun.
Subjective norm	My best friend thinks I should be physically active during my free time on most days. My mother or female guardian thinks I should be physically active during my free time on most days.
Perceived behavioral control	I have control over my being physically active during my free time on most days. If I want to be I can be physically active during my free time on most days.
Self-efficacy	I can be physically active during my free time on most days even if I could watch TV or play video games instead. I can be physically active during my free time on most days even if it is very hot or cold outside.

The 3DPAR required participants to recall physical activity from 3 previous days of the week: 2 weekdays and 1 weekend day. Data were reduced to the number of 30-min blocks per day in which the main activity was between three and six metabolic equivalents (METs; i.e., moderate physical activity [MPA]) and six or more METs (i.e., vigorous physical activity [VPA]); the corresponding number of blocks per day served as the three indicators of MPA and VPA. The validity of the 3DPAR has been established on the basis of comparisons of scores between athletes and nonathletes (Pires et al., 2001) and correlations with a self-report measure of sport involvement (Motl et al., 2001) and an objective measure of physical activity (Pate, Ross, Dowda, Trost, & Sirard, in press).

Data Analyses

Analyses were performed using full-information maximum-likelihood (FIML) estimation in AMOS 4.0 (SmallWaters Corp., Chicago, IL; Arbuckle & Wothke, 1999). FIML was selected because there were missing data. Missing data are common in school-based research involving large samples and can be attributed to item nonresponse. FIML is an optimal method for the treatment of missing data in SEM (Arbuckle & Wothke, 1999) and has yielded accurate fit indices with simulated missing data (Arbuckle, 1996; Enders & Bandalos, 2001). Although researchers have not evaluated fit indices from FIML estimation with ordered categorical data, maximum-likelihood estimation has resulted in accurate fit indices with ordered categorical data of varying degrees of skewness and kurtosis (Hutchinson & Olmos, 1998). The size of the sample was adequate to estimate the models (Bollen, 1989; Jöreskog & Sörbom, 1996). The ratio of participants to estimated parameters exceeded 10:1.

Model specification. The two-step procedure was used to test the theoretically based relationships among the latent variables (Anderson & Gerbing, 1988). The first step involved using confirmatory factor analysis (CFA) to test an overall measurement model. The overall measurement model displayed in Figure 2 consisted of eight unidimensional latent variables (i.e., attitude, subjective norm, behavioral control, self-efficacy, intention, expectation, and moderate and vigorous physical activity) that were interrelated. The factor loading for the first item on each latent variable was constrained to 1.0 to establish its metric. Correlated uniquenesses were specified between four pairs of items on the subjective norm latent variable (Dishman et al., 2002; Motl et al., 2000). The overall measurement model served as a baseline model for the structural model.

The second step involved using SEM to test a structural model. The structural model depicted in Figure 3 consisted of theoretically based relationships among the exogenous (i.e., independent variables not receiving, but emanating paths) and endogenous (i.e., dependent variables receiving paths) latent variables. The individual measurement models for the self-efficacy, attitude, subjective norm, and perceived behavioral control exogenous latent variables were specified to be unidimensional and interrelated. The factor loading for the first item on each latent variable was constrained to 1.0 to establish its metric. As previously noted, correlated uniquenesses were specified between four pairs of items on the subjective norm latent variable.

The individual measurement models for the intention, expectation, and moderate and vigorous physical activity endogenous latent variables were specified to be unidimensional, and a single correlation was estimated between intention and expectation. The factor loading for the first item on each endogenous latent variable was constrained to 1.0 to establish its metric. There were no correlated uniquenesses.

The structural model included paths from self-efficacy, attitude, subjective norm, and perceived behavioral control to intention and expectation. It also included paths from self-efficacy, perceived behavioral control, intention, and expectation to the moderate and vigorous physical activity.

Model fit. The chi-square statistic tests absolute fit of the model to the data, but it is sensitive to sample size and often inflates Type 1 error for the detection of small and potentially meaningless differences in nested models (Bollen, 1989; Jöreskog, 1993; Jöreskog & Sörbom, 1996). Thus, other ad hoc indices were used to judge model fit. The root-mean-square error of

approximation (RMSEA) represents closeness of fit. Values approximating .06 and zero demonstrate close and exact fit of the model, respectively (Browne & Cudeck, 1993; Hu & Bentler, 1999). The 90% confidence interval (CI) around the RMSEA point estimate should contain .06 or zero to indicate the possibilities of close or exact fit. The relative noncentrality index (RNI) and nonnormed fit index (NNFI) are incremental fit indices (Bentler & Bonett, 1980; McDonald & Marsh, 1990) and were selected on the basis of performance in simulation studies (Hu & Bentler, 1999; Marsh, Balla, & Hau, 1996). Minimally acceptable fit was based on threshold RNI and NNFI values of 0.90 (Bentler & Bonett, 1980; McDonald & Marsh, 1990); values approximating 0.95 were indicative of good fit (Hu & Bentler, 1999). The factor loadings, uniquenesses, path coefficients, factor correlations, standard errors, *t* values, and squared multiple correlations were inspected for appropriate sign or magnitude (Bollen, 1989; Jöreskog, 1993)¹. The *R*² values were reported for the endogenous variables as estimates of variance explained by the exogenous and endogenous variables.

Model modification. Model modifications were conducted using an iterative process that involved removing a single path with a nonsignificant *t* value and then reestimating the model (Jöreskog, 1993; Jöreskog & Sörbom, 1996). Paths with nonsignificant *t* values were removed because no substantively meaningful interpretation can be provided for the parameter estimates (Jöreskog, 1993). When the nonsignificant path was removed from the structural model, we expected the model fit to be unchanged. Model fit was assessed based on chi-square difference tests and comparisons of the ad hoc fit indices.

Invariance analysis. We tested the invariance of the structural model between Black (*n* = 896) and White (*n* = 823) girls using a multistep procedure (Bollen, 1989; Motl et al., 2001). Initially, we tested the structural model in the separate samples of Black and White girls. We then tested five nested models. The five nested models involved the invariance of the overall structure (i.e., same pattern of fixed, freed, and constrained factor loadings, path coefficients, factor variances–covariances, and uniquenesses), factor loadings (i.e., equality of coefficients linking the items with latent variables), path coefficients (i.e., equality of coefficients linking the latent variables), factor variances and covariances, and item uniquenesses and correlations between uniquenesses (i.e., equality of random and specific error variance for each item). Invariance was evaluated by a chi-square difference test, RMSEA with 90% CI, RNI, and NNFI.

Results

Descriptive Statistics

The overall means and standard deviations for the items on the questionnaires are provided in Table 2. The overall means for the univariate estimates of skewness and kurtosis for the questionnaire items also are provided in Table 2.

Confirmatory Factor Analysis

The eight-factor measurement model displayed in Figure 2 represented a good fit, $\chi^2(747, N = 1,797) = 2,039.51, p < .0001$, RMSEA = 0.031 (90% CI = 0.029–0.033), RNI = 0.94, NNFI = 0.94. All but one of the interfactor correlations were statistically significant; the nonsignificant correlation was between moderate and vigorous physical activity ($r = -.02, p = .584$) and was consistent with an orthogonal factor structure underlying measures of moderate and vigorous physical activity and strength and flex-

¹ The factor loadings, uniquenesses, standard errors, *t* values, and squared multiple correlations are available on request from Rod K. Dishman.

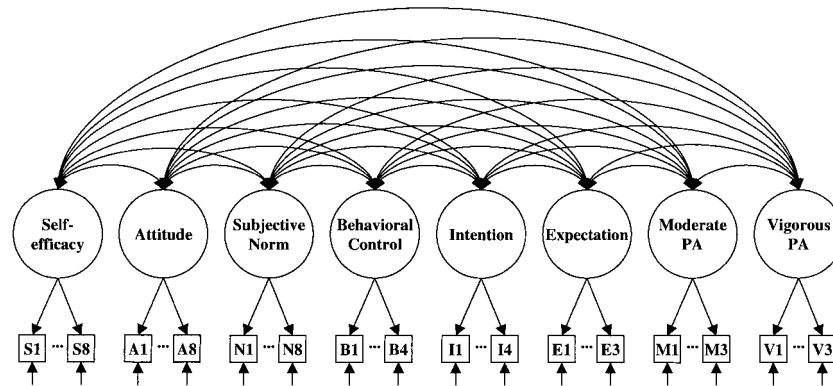


Figure 2. Overall measurement model illustrating the relationships among the eight latent variables tested using confirmatory factor analysis. Only the first and last items for each latent variable and uncorrelated uniquenesses were included to improve clarity of the presentation. PA = physical activity.

ibility (Prochaska, Sallis, Sarkin, & Calfas, 2000). We removed the correlation between moderate and vigorous physical activity and reestimated the model. The model represented a good fit, $\chi^2(748, N = 1,797) = 2,039.81, p < .0001$, RMSEA = 0.031 (90% CI = 0.029–0.033), RNI = 0.94, NNFI = 0.94. The interfactor correlations presented in Table 3 were significant and ranged between .09 and .82 ($M = .38, Mdn = .36$). The interfactor correlations indicated that the relationships among the latent variables were small to large in magnitude. The magnitude of the correlations demonstrated that it was feasible to test a theoretically based structural model to describe the interrelationships.

Structural Equation Modeling

The structural model presented in Figure 3 represented a good fit to the data, $\chi^2(752, N = 1,797) = 2,049.80, p < .0001$, RMSEA = 0.031 (90% CI = 0.029–0.033), RNI = 0.94, NNFI = 0.94, but it could be improved to be more parsimonious because there were nonsignificant paths between several exogenous and endogenous latent variables (Jöreskog, 1993). Through a series of seven modifications,² the final model represented a good fit to the data, $\chi^2(759, N = 1,797) = 2,056.62, p < .0001$, RMSEA = 0.031 (90% CI = 0.029 – 0.032), RNI = 0.94, NNFI = 0.95, and contained only significant paths. The final model did not differ from the eight-factor measurement model, $\chi^2_{diff}(11, N = 1,797) = 16.81, p = .11$, or the initial structural model, $\chi^2_{diff}(7, N = 1,797) = 6.82, p = .45$; the RMSEA, RNI, and NNFI were identical across the three models.

As indicated by the solid lines in Figure 3, there were significant direct effects between (a) self-efficacy and intention, expectation, and moderate and vigorous physical activity; (b) attitude and intention and expectation; (c) subjective norm and intention; and (d) perceived behavioral control and expectation and vigorous physical activity. The correlation between intention and expectation was significant, and there were significant correlations among the exogenous latent variables.³ The R^2 values were .69, .45, .06, and .11 for intention, expectation, moderate physical activity, and vigorous physical activity, respectively. The social-cognitive variables explained a large amount of variance in intention and expectation but only a modest amount of variance in moderate and vigorous physical activity.

We tested the invariance of the structural model across race, and the results are presented in Table 4. The structural model fit acceptably in the samples of Black and White girls. On the basis of the overlapping and acceptable RMSEA, RNI, and NNFI values, the nested SEMs provided support for the invariance of the overall structure (Model 1), factor loadings (Model 2), path coefficients (Model 3), and factor variances and covariances (Model 4). The uniquenesses and correlations between uniquenesses were not invariant across race (Model 5).

Discussion

Self-efficacy and perceived behavioral control were the primary correlates of physical activity among adolescent girls in the present study. The relationship between self-efficacy and physical activity agrees with previous reports of bivariate relationships among smaller samples of adolescent boys and girls (e.g., Trost et al., 1997; Trost, Pate, Ward, Saunders, & Riner, 1999). To our knowledge, we have provided the initial evidence linking perceived behavioral control with physical activity among adolescent girls. Future researchers should target self-efficacy and perceived behavioral control as possible mediators in interventions designed to increase physical activity in adolescent girls (Baranowski et al., 1998). It is important to note that these constructs are likely influenced by different intervention strategies. Self-efficacy is constrained to beliefs about personal ability; is sensitive to reinforcement history in specific settings; and should be readily influenced by observational learning, persuasion, and perceived exertion (Bandura, 1997), which can be quickly manipulated in physical activity settings. Perceived behavioral control encompasses beliefs about external control as well as personal ability and may represent more generalized beliefs about environmental in-

² The description of the step-by-step process of model modifications is available on request from Rod K. Dishman.

³ The magnitude of the correlation between self-efficacy and outcome expectancies in the present model is identical to the magnitude of a path specified from self-efficacy to outcome expectancies. The exact specification of the relationship does not affect the magnitude of any other relationships or paths in the structural model.

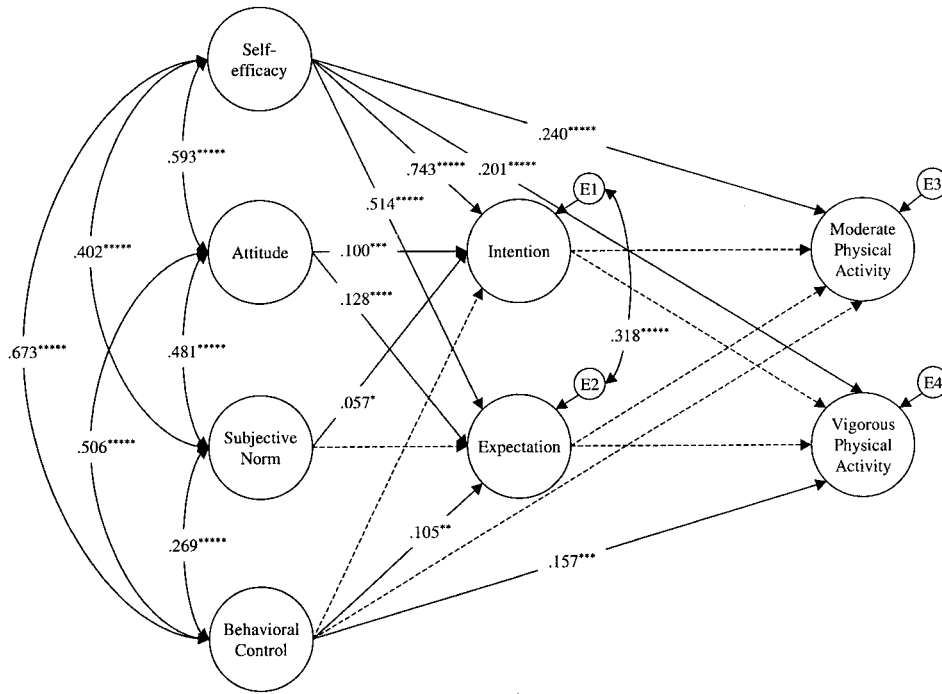


Figure 3. Model illustrating the theoretically based relationships among the exogenous (i.e., self-efficacy, attitude, subjective norm, and behavioral control) and endogenous (i.e., intention, expectation, and moderate and vigorous physical activity) latent variables tested using structural equation modeling (SEM). To improve the clarity of the figure, the items and uniquenesses were not included. Solid lines within the model represent statistically significant relationships, and dashed lines represent nonsignificant relationships on the basis of the results of the SEM analyses. Only statistically significant path coefficients are provided in the model. E = disturbance term. * $p < .05$. ** $p < .01$. *** $p < .005$. **** $p < .0005$. ***** $p < .0001$.

fluences on reinforcement that are less easily changed by focused, short-term interventions (Rotter, 1960).

Using SEM, we tested the primacy, independence, and interrelationships of components within TRA, TPB, and SET for understanding moderate and vigorous physical activity in a large sample

Table 2
Summary Descriptive and Distributional Statistics for Items on the Questionnaires Measuring Attitude, Subjective Norm, Perceived Behavioral Control, Self-Efficacy, Intention, Expectation, and Moderate and Vigorous Physical Activity

Questionnaire	M	SD	Kurtosis	Skewness
Attitude (8 items)	17.89	6.05	0.53	-0.75
Subjective norm (8 items)	11.36	7.07	-0.51	0.42
Perceived behavioral control (4 items)	4.09	1.00	0.83	-1.11
Self-efficacy (8 items)	3.74	1.13	0.13	-0.83
Intention (4 items)	3.94	1.06	0.46	-0.99
Expectation (3 items)	3.97	1.07	0.46	-1.02
Moderate physical activity (3 items)	2.26	2.66	3.19	1.55
Vigorous physical activity (3 items)	1.06	1.89	10.07	2.62

Note. Scores for moderate and vigorous physical activity reflect the number of 30-min blocks per day in which the main activity was between three and six metabolic equivalents (METs) and six or more METs, respectively.

of Black and White adolescent girls. SET had the strongest support. Self-efficacy was independently related to moderate and vigorous physical activity, and it accounted for the effect of intention on physical activity among the adolescent girls. Thus, previous reports of a relationship between intention and physical activity may reflect unmeasured, third-variable influences such as self-efficacy or habit on physical activity (Dishman, 1994; Godin, 1994).

Modest support was provided for TPB in relation to physical activity among the adolescent girls. Attitude and subjective norm were related to intention, but intention was unrelated to moderate or vigorous physical activity. Perceived behavioral control was independently related to vigorous physical activity but unrelated to intention or moderate physical activity. Previous researchers have examined the relationship between perceived behavioral control and intention to be physically active in adolescent boys and girls (e.g., Craig et al., 1996; Hagger, Chatzisarantis, & Biddle, 2001; Hagger, Chatzisarantis, Biddle, & Orbell, 2001; Mummery et al., 2000) but have not directly examined the relationship between perceived behavioral control and physical activity. Therefore, as proposed by TPB, perceived behavioral control directly affects physical activity among adolescent girls.

Weak support was provided for TRA in relation to physical activity among adolescent girls. Although attitude and subjective norm were related to intention, intention was unrelated to physical activity. Physical activity among adolescent girls does not appear to be influenced by intention and, hence, rational decisions, as

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Table 3
Interfactor Correlations Among the Eight Latent Variables in the Overall Measurement Model Tested With CFA

Variable	1	2	3	4	5	6	7	8
1. Attitude	—							
2. Subjective norm	.48***	—						
3. Perceived control	.51***	.27***	—					
4. Self-efficacy	.59***	.40***	.67***	—				
5. Intention	.57***	.40***	.58***	.82***	—			
6. Expectation	.49***	.29***	.52***	.66***	.69***	—		
7. Moderate PA	.18***	.12**	.11*	.24***	.22***	.19***	—	
8. Vigorous PA	.18***	.09*	.29***	.31***	.27***	.22***	—	—

Note. CFA = confirmatory factor analysis; PA = physical activity.

* $p < .005$. ** $p < .001$. *** $p < .0001$.

suggested by TRA. Intention also does not appear to mediate the effect of attitude and subjective norm on physical activity among adolescent girls.

We examined the possible redundancy of perceived behavioral control and self-efficacy in explaining variation in physical activity among adolescent girls by using measures of perceived difficulty and perceived capability (Ajzen, 1991; Bandura, 1997). Perceived behavioral control and self-efficacy were strongly correlated ($r = .67$), and both perceived behavioral control and self-efficacy were related to vigorous physical activity. However, only self-efficacy was related to moderate physical activity. Hence, despite their strong association, perceived behavioral control and self-efficacy, as operationally defined in the present study, do not appear to be redundant constructs in explaining variation in physical activity among young girls. Dziewaltowski et al. (1990, p. 398) reached a similar conclusion in a sample of college-aged students. Bandura's (1997) view that perceived behavioral control and self-efficacy are redundant in explaining variation in health behaviors may not be applicable to physical activity or the measures we used.

Our results provide additional evidence that social-cognitive correlates differ according to the intensity of physical activity (e.g., Trost et al., 1997; Trost et al., 1999). Both self-efficacy and perceived behavioral control were related to vigorous physical activity, but only self-efficacy was related to moderate physical activity. These findings may have practical importance for public health interventions (Dishman, 1994; Sallis et al., 1992), because moderate and vigorous physical activity are believed to be associated with different health and fitness consequences (Bouchard, 2001). Interventions designed to change moderate or vigorous physical activity might need to target different social-cognitive variables. Theoretically, our finding that self-efficacy was related to both moderate and vigorous physical activity in the presence of incentives (e.g., outcome-expectancy values) agrees with SET. SET posits that self-efficacy is associated with the intensity of behavior (Bandura, 1997).

There was a weak relationship between subjective norm and intention. Although the weak relationship may be sample specific, it agrees with previous reports of an inconsistent association between the normative belief and intention among adults (Godin,

Table 4
Structural Equation Model Analyses Testing for Invariance Across Race

Model	χ^2	<i>df</i>	RMSEA (90% CI)	RNI	NNFI
Black girls	1,542.46*** ^a	759	0.034 (0.032–0.036)	0.93	0.92
White girls	1,433.26*** ^b	759	0.033 (0.030–0.035)	0.94	0.94
Model 1	2,975.72*** ^c	1518	0.024 (0.022–0.025)	0.93	0.93
Model 2	3,093.30*** ^c	1551	0.024 (0.023–0.025)	0.93	0.93
Model 3	3,112.26*** ^c	1560	0.024 (0.023–0.025)	0.93	0.93
Model 4	3,177.40*** ^c	1575	0.024 (0.023–0.026)	0.93	0.93
Model 5	4,653.80*** ^c	1620	0.033 (0.032–0.034)	0.89	0.89

Model comparison	χ^2_{diff}	<i>df</i>
Model 1 vs. 2	85.99***	29
Model 2 vs. 3	8.83†	3
Model 3 vs. 4	5.68††	5
Model 4 vs. 5	739.25***	71

Note. RMSEA = root-mean-square error of approximation; CI = confidence interval; RNI = relative noncentrality index; NNFI = nonnormed fit index.

^a $N = 896$. ^b $N = 823$. ^c $N = 1,719$.

† $p = .032$. †† $p = .339$. *** $p < .0001$.

1994) and youth (Hagger, Chatzisarantis, & Biddle, 2001; Hagger, Chatzisarantis, Biddle, & Orbell, 2001). This finding is surprising because peers would seem to be an important influence on participation in physical activity among youth. Future research is encouraged that would generate a multidimensional measure of subjective norm that contains a component related to peer influences. Such an approach might better predict an individual's intention than a global, unidimensional measure of subjective norm.

When examining TRA and TPB in relation to physical activity, some studies have used questions that appear to measure the individual's expectation rather than intention to be physically active (Courneya & McAuley, 1993; Warshaw & Davis, 1985). Intention and expectation may be differentially related to physical activity and may have different relationships with self-efficacy and components of TRA and TPB (Courneya & McAuley, 1993). We found that self-efficacy, attitude, and subjective norm were significantly related to intention. Self-efficacy, attitude, and perceived behavioral control were significantly related to expectation. Though intention and expectation were correlated, neither variable was related to moderate or vigorous physical activity. Our results imply that intention and expectation do not have unique relationships with components of TRA, TPB, and SET or physical activity in this sample of adolescent girls.

Because participation in vigorous physical activity differs according to race (Centers for Disease Control and Prevention, 1998), we compared the relationships among components of TRA, TPB, and SET with physical activity between the Black and White girls in our sample. The invariance analysis provided support for the similarity of the structure, factor loadings, path coefficients, and factor variances and covariances, but not for the uniquenesses or correlations between uniquenesses, across race. Hence, the social-cognitive and physical activity latent variables were measured similarly, and their relationships with physical activity were similar, between the Black and White girls.

In summary, the present study helps clarify the independence and primacy of components of TRA, TPB, and SET for the purpose of understanding intention and moderate and vigorous physical activity in Black and White adolescent girls from South Carolina; our findings might not generalize to adolescent boys. Though attitude and subjective norm were related to intention, as predicted by TRA and TPB, intention was not related to moderate or vigorous physical activity. Moreover, contrary to a prior concern (Courneya & McAuley, 1993), intention and expectation were not differentially related to components of TRA, TPB, and SET or to physical activity. Perceived behavioral control was related to vigorous physical activity, but it did not predict intention or moderate physical activity. Self-efficacy was related to moderate and vigorous physical activity and accounted for the effect of intention on physical activity. To our knowledge, these findings provide the first evidence derived from covariance modeling that supports self-efficacy and perceived behavioral control as possible mediator variables (Baranowski et al., 1998; Dishman, 1994) that are feasible targets of interventions designed to increase vigorous physical activity in Black and White adolescent girls.

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