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Comparison of Barriers Self-Efficacy and Perceived Behavioral Control for Explaining Physical Activity Across 1 Year Among Adolescent Girls

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The absence of longitudinal data about correlates of physical activity during adolescence has hindered the identification of key mediator variables that can be targeted by interventions. Building on the authors' previous report of a cross-sectional analysis, this study compared barriers self-efficacy and perceived behavioral control as predictors of change in 2 levels of physical activity across a 1-year period among a sample of Black and White adolescent girls ($N = 1{,}038$). Self-efficacy did not predict change in either moderate or vigorous physical activity. In contrast, perceived behavioral control exhibited a longitudinal, independent relationship with change in vigorous physical activity. The authors concluded that perceived behavioral control is an independent predictor of change in vigorous physical activity levels across a 1-year period among a sample of Black and White adolescent girls and warrants study as a potential mediator variable in interventions designed to increase or maintain physical activity.

Keywords: physical activity, adolescents, determinants, race

The increasing prevalence of inactivity during adolescence among girls in the United States (Grunbaum et al., 2002; Kimm et al., 2002) has heightened public health interest in the need for successful physical activity interventions. The identification of correlates of physical activity (i.e., bodily movement that results in energy expenditure) is an important step toward informing such interventions about key mediators of behavior that can be targeted for change in order to increase physical activity (Baranowski, Anderson, & Carmack, 1998; Dishman, 1982, 1991, 1994; Lewis, Marcus, Pate, & Dunn, 2002; Sallis, Prochaska, & Taylor, 2000). However, the absence of longitudinal data on correlates of physical activity (Gordon-Larsen, McMurray, & Popkin, 2000; Sallis et al., 2000) has hindered the identification of putative mediators that are empirically supported as influences on change in physical activity among adolescents.

Self-efficacy and perceived behavioral control each provide a conceptually distinct explanation of persistence in physical activity. Self-efficacy represents "beliefs in one's capabilities to organize and execute the courses of action required to produce a given attainment" (Bandura, 1997, p. 3). Perceived behavioral control represents "people's perception of the ease or difficulty of performing the behavior of interest" (Ajzen, 1991, p. 183) and is influenced by internal and external factors. Internal factors include beliefs about skills, abilities, and willpower, whereas external factors include time, opportunity, and dependence on others (Ajzen, 1991). Hence, self-efficacy focuses on factors internal to the individual, whereas perceived behavioral control reflects external and internal factors (Ajzen & Timko, 1986).

Despite the aforementioned conceptual distinctions, there is some disagreement about the degree of redundancy between self-efficacy and perceived behavioral control in explaining variation in health behaviors (e.g., Bandura, 1997; Dzewaltowski, Noble, & Shaw, 1990; Hagger, Chatzisarantis, & Biddle, 2002). We previously reported that barriers self-efficacy and perceived behavioral control were independently related to physical activity in a cross-sectional analysis of adolescent Black and White girls (Motl et al., 2002). To date, we are unaware of studies that have directly compared the independence and redundancy of self-efficacy and perceived behavioral control for predicting naturally occurring changes in adolescent physical activity.

In this brief report, we extend our previous cross-sectional analysis (Motl et al., 2002) by evaluating the independent and comparative utility of the barriers self-efficacy and perceived behavioral control for predicting naturally occurring changes in two levels of physical activity across a 1-year period among a cohort of Black and White adolescent girls. We expected that (a) self-efficacy and perceived behavioral control would independently predict naturally occurring change in vigorous physical

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activity (VPA), and (b) self-efficacy would independently predict naturally occurring change in moderate physical activity (MPA).

Method

Participants

Participants were eighth- and ninth-grade girls recruited from 24 high schools (and their associated middle schools) in South Carolina. The high 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. The 24 high schools were randomly assigned to treatment or control conditions, and only participants from the 12 control schools were included in this study. There were 1,964 girls enrolled and eligible in the control schools, and 52.9% of the girls participated in the measurement component of the study ($N = 1{,}038$). There were 856 girls who provided baseline data and 853 girls who provided follow-up data, with approximately 61% of the girls providing data on both occasions. The sample initially had a mean age of 13.6 years ($SD = 0.6$) and racial percentages of 40.6% African American, 38.9% Caucasian, and 3% other; 17.5% of the girls did not report race.

Measures

We have previously described the development and psychometric properties of the measures of the barriers self-efficacy and perceived behavioral control (Dishman et al., 2002; Motl et al., 2000). The measure of barriers self-efficacy contained eight items rated on a 5-point scale ranging from 1 (*disagree a lot*) to 5 (*agree a lot*). The measure of perceived behavioral control contained four items. Three items were rated on a 5-point scale ranging from 1 (*agree a lot*) to 5 (*disagree a lot*). One item was rated on a 5-point scale ranging from 1 (*very easy*) to 5 (*very difficult*). We reverse scored the items such that higher scores reflected greater levels of perceived behavioral control. The scales for each variable have conformed to a unidimensional model that was invariant across 1 year (Motl et al., 2000) and between Black and White girls (Dishman et al., 2002). The intrafactor correlations from the analyses of invariance across 1 year were .61 and .55 for self-efficacy and perceived behavioral control, respectively.

Physical activity was measured with the 3-Day Physical Activity Recall (3DPAR; Pate, Ross, Dowda, Trost, & Sirard, 2003), which provides an estimate of usual physical activity. The 3DPAR required participants to recall physical activity behavior from 3 previous days of the week (first Tuesday, then Monday, then Sunday); the instrument always was completed on Wednesday. Those 3 days were selected to capture physical activity on 1 weekend day and 2 weekdays. To improve the accuracy of physical activity recall, we segmented the 3 days into thirty-four 30-min time blocks, beginning at 7:00 a.m. and continuing through to 12:00 a.m. To further aid recall, we grouped the thirty-four 30-min blocks into broader time periods (i.e., before school, during school, lunchtime, after school, supper time, and evening). The 3DPAR included a list of 55 commonly performed activities grouped into broad categories (i.e., eating, work, afterschool/spare time/hobbies, transportation, sleeping/bathing, school, and physical activities and sports) to improve activity recall. For every one of the thirty-four 30-min time blocks, students reported the main activity performed and then rated the relative intensity of the activity as light, moderate, hard, or very hard. To help students select a relative intensity, the instrument included illustrations depicting activities representative of the various intensities. The data were converted into the number of 30-min blocks per day in which the main activity was between three and six METs (metabolic equivalents of physical activity; i.e., MPA) and six or more METs (i.e., VPA). Hence, the unit of analysis was the number of 30-min blocks per day of MPA and VPA for each of the 3 days. The number of 30-min blocks per day served as the three indicators of MPA and VPA. The validity of MPA and VPA estimated by 3DPAR has been supported by small to moderate correlations with a concurrent self-report of team sport involvement ($r = .25–.27$; Motl, Dishman, Felton, & Pate, 2003) and an objective measure of physical activity assessed by accelerometry across a 7-day period ($r = .35–.45$; Pate et al., 2003). The correlations were similar in magnitude to those reported for other measures of physical activity among adolescents (Sirard & Pate, 2001). The intrafactor correlations from an analysis of invariance across 1 year were .32 and .43 for MPA and VPA, respectively (Motl, Dishman, Dowda, & Pate, 2004).

Procedure

The procedure was approved by the University of South Carolina Institutional Review Board, and participants and the parent or legal guardian provided written informed consent. The measures were administered in groups of 6–10 girls by trained data collectors in the spring semesters of 1999 (baseline) and 2000 (follow-up) when students were in the eighth and ninth grades.

Data Analysis

Structural equation modeling (SEM) was performed using full-information maximum likelihood (FIML) estimation in LISREL 8.50 (Jöreskog & Sörbom, 1996). FIML was selected because there were missing responses to items on the questionnaires. The extent of missing data ranged from 18.9% for the follow-up measure of perceived behavioral control to 25.7% for the baseline measure of MPA. The presence of missing data is common in school-based studies of physical activity that involve large samples and is often the result of a participant's absence on the day of data collection and of item nonresponse. The presence of missing data was not explainable by race. FIML is an optimal method for the treatment of missing data in SEM and has yielded accurate parameter estimates and fit indices with up to 25% of simulated missing data (Arbuckle, 1996; Enders, 2001; Enders & Bandalos, 2001); we are unaware of studies evaluating missing data techniques in SEM with higher rates of missing data. Other missing data techniques, particularly pairwise and listwise deletion of cases, have yielded biased parameter estimates and fit indices (Arbuckle, 1996; Enders, 2001; Enders & Bandalos, 2001).

Model specification. The model tested with SEM is presented in Figure 1. The individual measurement models for the measures of self-efficacy, perceived behavioral control, MPA, and VPA were specified to be unidimensional. The measurement models enabled for an accounting of the common variance among items and removed the random and specific measurement errors (Bollen, 1989). The structural model included (a) paths between the same latent variables assessed at baseline and follow-up (Kessler & Greenberg, 1981) and (b) paths from self-efficacy and perceived behavioral control to MPA and VPA at baseline and the 1-year follow-up. There were correlations between the self-efficacy and perceived behavioral control exogenous latent variables at baseline and between error terms for the self-efficacy and perceived behavioral control endogenous variables at follow-up. There also were autocorrelations among the uniquenesses of identical items across time (Kessler & Greenberg, 1981).

Model fit. Model fit was assessed with multiple indices. The chi-square statistic assessed absolute fit of the model to the data (Jöreskog & Sörbom, 1996). The root-mean-square error of approximation (RMSEA) represented closeness of fit, and values approximating .06 and 0 demonstrated close and exact fits of the model, respectively (Browne & Cudeck, 1993; Hu & Bentler, 1999). The comparative fit index (CFI) and nonnormed fit index (NNFI) tested the proportionate improvement in fit by comparing the target model with the independence model (Bentler, 1990; Bentler & Bonett, 1980). Minimally acceptable fit was based on CFI and NNFI values of .90 (Bentler, 1990; Bentler & Bonett, 1980); values approximating .95 indicated good fit (Hu & Bentler, 1999). The parameter estimates, standard

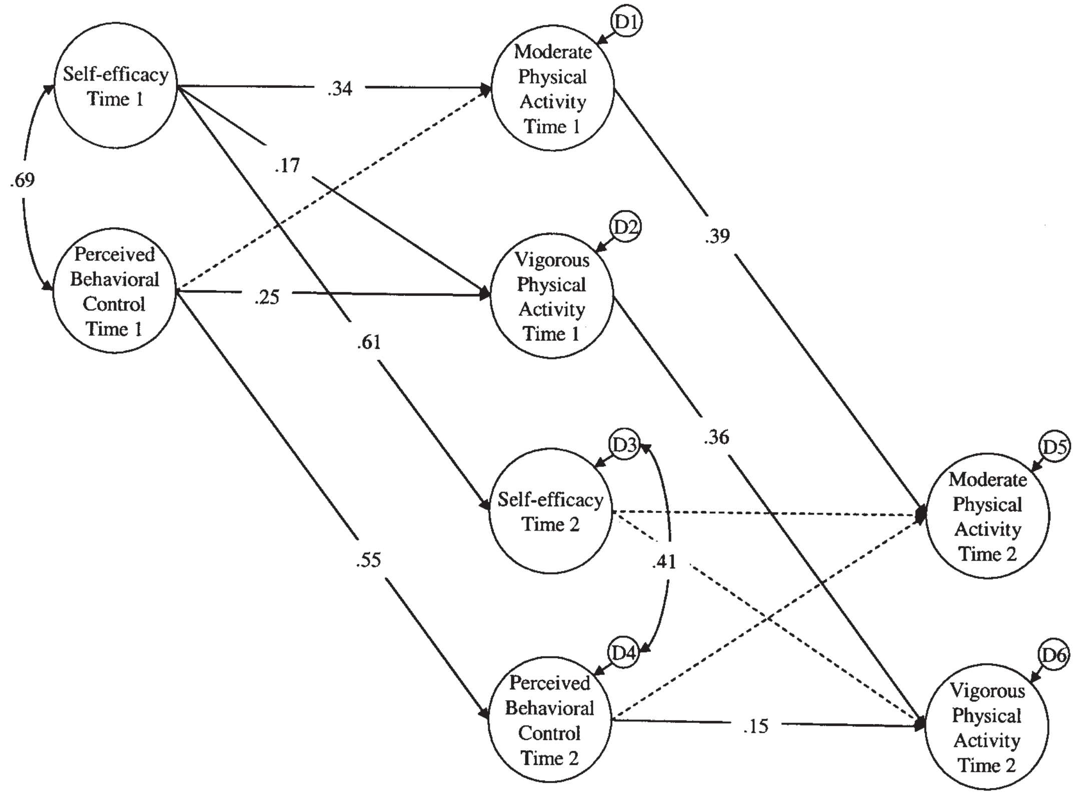

Figure 1. Panel model illustrating the longitudinal relationships among self-efficacy, perceived behavioral control, and moderate and vigorous physical activity tested with structural equation modeling (SEM). The items and uniquenesses were not included to improve the clarity of the figure. Solid lines within the model represent statistically significant relationships, and dashed lines represent nonsignificant relationships on the basis of results of the SEM analyses. Only statistically significant ($p < .05$) path coefficients are provided in the model. D = disturbance.

errors, z statistics, and squared multiple correlations were inspected for sign and magnitude.

Results

Descriptive Statistics

The overall means (computed with unity weights for each of the observed indicators) and standard deviations for the social–cognitive and physical activity measures, and the measures of mass, height, and body mass index (BMI), are provided separately for Black and White girls across time in Table 1. The girls reported participating in an average of approximately two 30-min blocks of MPA per day and an average of approximately one 30-min block of VPA per day. Consistent with population estimates for girls of this age (Grunbaum et al., 2002), the level of physical activity did not change significantly across baseline and follow-up. Nonethe-

Table 1
Descriptive Statistics (M ± SD) for the Measures of Social–Cognitive, Physical Activity, and Morphological Variables at Baseline and Follow-Up for White and Black Girls

	White girls		Black girls	
Measure	Baseline	Follow-up	Baseline	Follow-up
Self-efficacy	31.0 ± 5.1	30.5 ± 5.2	28.7 ± 6.0	28.0 ± 6.3
Perceived control	16.7 ± 2.7	16.5 ± 2.7	16.1 ± 2.7	15.8 ± 2.8
Moderate physical activity	7.8 ± 6.4	8.0 ± 6.1	5.8 ± 5.4	6.4 ± 5.9
Vigorous physical activity	3.8 ± 4.8	3.3 ± 4.2	2.6 ± 3.6	3.0 ± 4.8
Height (cm)	161.2 ± 6.5	162.9 ± 6.5	161.5 ± 6.5	162.3 ± 6.5
Weight (kg)	58.6 ± 16.1	60.8 ± 16.1	62.7 ± 17.2	65.6 ± 18.1
Body mass index	22.4 ± 5.2	22.8 ± 5.4	23.9 ± 4.0	24.8 ± 6.4

less, there was substantial variation in levels of MPA and VPA, thereby allowing for an analysis of naturally occurring changes in physical activity within girls across time. On the basis of a frequency analysis, only 10% of the girls reported no participation in MPA, and 30% reported no participation in VPA. The pattern of activity is both consistent with data from the 2001 Youth Risk Behavior Surveillance and below national objectives for adolescents (Grunbaum et al., 2002). The most frequently reported types of activities included walking, basketball, jogging/running, bicycling, and social dancing. The relationships among study variables are provided in Table 2.

Structural Equation Modeling

The panel model depicted in Figure 1 represented an acceptable-to-good fit: $\chi^2(562) = 972.90$, $p < .01$ (RMSEA = .027, 90% confidence interval [CI] = .024−.029, NNFI = .93, CFI = .94). The significant parameter estimates among the latent variables are provided in Figure 1. With the follow-up measurement, there was a statistically significant relationship from perceived behavioral control to VPA ($\beta_{64} = .15$). As described by Kessler and Greenberg (1981), any relationships observed with the follow-up measurement can be interpreted in terms of the changes in the predictors on residual change in the outcomes. Hence, a 1 standard deviation unit change in perceived behavioral control was associated with a 0.15 standard deviation unit change in VPA. As expected on the basis of our previous cross-sectional research with a larger portion of the cohort (Motl et al., 2002), there were statistically significant relationships from self-efficacy to MPA ($\gamma_{11} = .34$) and from self-efficacy ($\gamma_{21} = .17$) and perceived behavioral control ($\gamma_{22} = .25$) to VPA with the baseline measurement.

The path or stability coefficients between the same latent variables across time were statistically significant for the social–cognitive variables of self-efficacy ($\gamma_{31} = .61$) and perceived behavioral control ($\gamma_{42} = .55$) and the physical activity variables of MPA ($\beta_{51} = .36$) and VPA ($\beta_{62} = .39$). The stability coefficients for the physical activity latent variables indicate that there were substantial changes in the rank ordering of participants across time, permitting a strong test of naturally occurring changes in physical activity. There were significant correlations among the measures of self-efficacy and perceived behavioral control at baseline ($\Phi_{12} = .69$) and follow-up ($\Psi_{34} = .41$). Though the correlation between self-efficacy and perceived behavioral control at baseline was strong, this is not an indication that the constructs were redundant because the correlation is significantly less than 1.0, which provides evidence of discriminant validity (Mallard & Lance, 1998).

Multigroup Invariance

We used a standard procedure (Motl et al., 2002) to test the invariance of the structural model between Black ($n = 421$) and White ($n = 404$) girls. The structural model fit acceptably in the samples of Black girls, $\chi^2(562) = 733.01$, $p < .01$ (RMSEA = .027, 90% CI = .021–.032, NNFI = .93, CFI = .94), and White girls, $\chi^2(562) = 765.20$, $p < .01$ (RMSEA = .030, 90% CI = .024−.035, NNFI = .92, CFI = .93). On the basis of the overlapping and acceptable RMSEA, NNFI, and CFI values, the nested SEMs provided support for the invariance of the overall structure, $\chi^2(1124) = 1{,}498.21$, $p < .01$ (RMSEA = .020, 90% CI = .017−.023, NNFI = .93, CFI = .93), factor loadings, $\chi^2(1156) = 1{,}555.80$, $p < .01$ (RMSEA = .020, 90% CI = .018–.023, NNFI = .93, CFI = .93), path coefficients, $\chi^2(1164) = 1{,}561.03$, $p < .01$ (RMSEA = .020, 90% CI = .018−.023, NNFI = .93, CFI = .93), and factor variances and covariances, $\chi^2(1174) = 1{,}598.01$, $p < .01$ (RMSEA = .021, 90% CI = .018–.023, NNFI = .93, CFI = .93). The uniquenesses were not invariant between race, $\chi^2(1210) = 1{,}971.90$, $p < .01$ (RMSEA = .028, 90% CI = .017−.023, NNFI = .86, CFI = .86).

Discussion

The primary novel finding of this study was that a change in perceived behavioral control predicted a residual change in VPA across a 1-year period among the adolescent girls. Although we previously reported a cross-sectional correlation between perceived behavioral control and VPA in this sample of adolescent girls (Motl et al., 2002), we now provide evidence linking a change in perceptions of behavioral control with a residual change in VPA across a 1-year period and between Black and White girls. This evidence provides empirical support for the theoretical view that

Table 2
Correlations Among Study Variables Measured on Two Occasions Separated by 1 Year

Variable	1	2	3	4	5	6	7	8
Baseline								
1. Self-efficacy	—							
2. Perceived control	.65*	—						
3. Vigorous physical activity	.34*	.33*	—					
4. Moderate physical activity	.24*	.10	−.02	—				
Follow-up								
5. Self-efficacy	.61*	.43*	.26*	.18*	—			
6. Perceived control	.43*	.51*	.30*	.04	.67*	—		
7. Vigorous physical activity	.18*	.21*	.43*	−.01	.17*	.23*	—	
8. Moderate physical activity	.14*	.13*	.06	.36*	.10*	.04	−.08	—

Note. Correlations were computed from an initial confirmatory factor analysis performed with full-information maximum likelihood estimation in LISREL 8.50.
* $p < .05$.

perceived behavioral control is a viable mediator of behavior that might be targeted by social–cognitive interventions designed to increase girls' physical activity during early adolescence. We note that a 1 standard deviation unit change in perceived behavioral control was related to a 0.15 standard deviation unit change in VPA. This might be of marginal clinical significance. When judged as a binomial effect (Rosenthal & Rubin, 1982), the statistical impact of an effect this size approximates an outcome of 7%–8% above a control rate, hypothetically benefiting about 70 girls in the present sample. Such an effect would be comparable to the effect reported for a physical activity intervention with children that targeted self-efficacy (Edmundson et al., 1996; Nader et al., 1999). However, the practical or clinical importance of our current findings cannot be directly determined on the basis of the observational design of this study.

The findings encourage the targeting of perceived behavioral control as a possible mediator in interventions designed to increase VPA in Black and White adolescent girls (Lewis et al., 2002). Perceived behavioral control encompasses beliefs about external control, as well as personal ability, and may be influenced by generalized beliefs about environmental influences on reinforcement (Ajzen, 1991) that are not easily changed by focused, short-term interventions. Thus, change in perceptions of behavioral control for physical activity may require ongoing, comprehensive social and environmental manipulations that affect beliefs about the difficulty of personal control over internal and external sources of reinforcement for being physically active. Variables such as increasing parental help and support, identifying opportunities to be active, and providing equipment, supplies, and access to facilities (Sallis et al., 2000) might be targets of ongoing, comprehensive social and environmental manipulations.

Self-efficacy exhibited cross-sectional relationships with MPA and VPA, as we previously observed in our cross-sectional analysis with a larger portion of the cohort (Motl et al., 2002). This agrees with previous studies of smaller samples of adolescent boys and girls (e.g., Trost, Pate, Ward, Saunders, & Riner, 1999). However, self-efficacy was not longitudinally related with changes in moderate and vigorous levels of physical activity. This finding, which contrasts with previous research among fifth-grade students (Trost et al., 1997), is likely the result of the present focus on self-efficacy for overcoming barriers to being physically active. Bandura (1997) has proposed that efficacy beliefs about overcoming barriers should predict exercise adoption, whereas efficacy beliefs more globally concerned with self-regulation of behavior should predict long-term exercise adherence. Hence, our results suggest that self-efficacy to overcome barriers might represent an important initial target for a physical activity intervention among adolescents, but other forms of efficacy, such as self-regulatory efficacy, are more important for long-term changes in physical activity.

Our results argue against the redundancy of self-efficacy and perceived behavioral control in explaining variation in physical activity among adolescent girls. Although self-efficacy and perceived behavioral control were significantly intercorrelated, there were unique and independent relationships with physical activity. For example, self-efficacy was related to initial levels of MPA, whereas both self-efficacy and perceived behavioral control were related to initial levels of VPA. Only perceived behavioral control was related to longitudinal changes in VPA. Hence, despite the moderate associations, self-efficacy and perceived behavioral control, as operationally defined in the present study, do not appear to be redundant constructs in explaining variation in physical activity among young girls. Others have reached a similar conclusion for self-efficacy and perceived behavioral control (Dzewaltowski et al., 1990; Hagger et al., 2002; Motl et al., 2002). Hence, the view that self-efficacy and perceived behavioral control are redundant or inconsequential in explaining variation in health behaviors (Bandura, 1997) may not be applicable to physical activity or the measures we used.

We now provide additional evidence that correlates of physical activity among youth differ according to the intensity of physical activity (e.g., Trost et al., 1997, 1999). Self-efficacy was related to baseline levels of MPA and VPA. Perceived behavioral control was related to baseline and follow-up levels of VPA. These findings may have practical importance for public health interventions (Dishman, 1994; Sallis et al., 1992), as MPA and VPA have different prevalence rates among youth (Grunbaum et al., 2002) and are believed to be associated with different health and fitness consequences (Bouchard, 2001). Interventions designed to change MPA and VPA might need to target different variables.

We recognize that other variables might be operating as covariates of change in the present study. Some of those variables include sociodemographic factors, which were not examined in the present study. The sociodemographic characteristics of the sample may be particularly relevant for self-efficacy and perceived behavioral control in adolescents, as those constructs are likely to be influenced by other significant adults (Bandura, 1997). Recent findings from a large population-based sample found that sociodemographic variables were related more so to physical inactivity rather than to moderate-to-vigorous physical activity (Gordon-Larsen et al., 2000). Nonetheless, these variables should be accounted for in subsequent investigations.

In summary, our primary novel finding was that a change in perceived behavioral control predicted a residual change in VPA across a 1-year period in a sample of Black and White adolescent girls from South Carolina. Perceived behavioral control appears to be an independent influence on naturally occurring change in physical activity among adolescent girls and warrants study as a potential mediator variable in physical activity interventions.

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