Development and Evaluation of Social Cognitive Measures Related to Adolescent Physical Activity

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Background: This study aimed to develop and evaluate the construct validity and reliability of modernized social cognitive measures relating to physical activity behaviors in adolescents. Methods: An instrument was developed based on constructs from Bandura’s Social Cognitive Theory and included the following scales: self-efficacy, situation (perceived physical environment), social support, behavioral strategies, and outcome expectations and expectancies. The questionnaire was administered in a sample of 171 adolescents (age = 13.6 ± 1.2 years, females = 61%). Confirmatory factor analysis was employed to examine model-fit for each scale using multiple indices, including chi-square index, comparative-fit index (CFI), goodness-of-fit index (GFI), and the root mean square error of approximation (RMSEA). Reliability properties were also examined (ICC and Cronbach’s alpha). Results: Each scale represented a statistically sound measure: fit indices indicated each model to be an adequate-to-exact fit to the data; internal consistency was acceptable to good (α = 0.63–0.79); rank order repeatability was strong (ICC = 0.82–0.91). Conclusions: Results support the validity and reliability of social cognitive scales relating to physical activity among adolescents. As such, the developed scales have utility for the identification of potential social cognitive correlates of youth physical activity, mediators of physical activity behavior changes and the testing of theoretical models based on Social Cognitive Theory.

Keywords: psychosocial measures, scales, youth, physical activity behavior

The health benefits of physical activity (PA) for children and adolescents are well documented. Participation in PA contributes to improved musculoskeletal health and the potential for reducing the risk for chronic disease such as Type 2 diabetes, cardiovascular disease, obesity, and certain cancers. Furthermore there is evidence for related psychosocial benefits including improvements in self esteem and self concept and a reduction in anxiety and depressive symptoms. Yet, unfortunately there is evidence indicating many adolescents are not sufficiently active and fail to meet PA guidelines.

Childhood and adolescence have been identified as critical periods for the establishment of health behaviors that are likely to track into adulthood. Hence, interventions targeting the PA behaviors of youth are important. However, many interventions directed at this population have been ineffectual or produced only modest outcomes for PA behavior change. Explanations for these findings may be a result of a number of methodological limitations in these studies, including atheoretical interventions, underpowered studies, weak assessment measures, inadequate intervention duration or intensity, poor program compliance or exposure, and a lack of tailored interventions that exclusively target priority groups.

The design and development of ineffective programs may also be due to inadequate understanding of the causal mechanisms of PA behavior change specific to children and adolescents. Theories of behavior change (eg, Social Cognitive Theory, Theory of Planned Behavior) postulate that there are underlying “mechanisms” through which intervention effects are achieved. By examining the role hypothesized variables (eg, intentions or social support) may have in mediating the pathway between an intervention and observed behavioral outcomes, researchers can establish which components of an intervention contributed wholly or partially to behavior change. Despite this knowledge, few studies have examined hypothesized mediators of PA intervention effects among children and adolescents.

Furthermore poor quality measures used to assess potential mediators has compounded the limited research and evidence for mediators of youth PA. In their recent review, Brown and Colleagues revealed the psychometric properties reported for reliability and validity by many measures for children and adolescents was substandard or limited implicating the potential for inaccurate conclusions regarding effective mediators and the efficacy of PA interventions. Moreover, it was suggested that instrument precision is problematic when modified versions of adult measures are employed in child and adolescent studies without prior testing.
It is clear a stronger evidence base is needed for mediators of PA behavior in developing an improved understanding of “what works” among youth to inform the design of more efficacious interventions. The use of valid and reliable measures that can lead to accurate conclusions regarding effective mediators is an essential component of this process. Hence, the aim of this study is to develop a novel, valid, and reliable questionnaire that assesses social cognitive measures relating to adolescent PA behaviors; has utility for population-based research in adolescents; and is suitable for use in adolescent observational and intervention studies to examine potential correlates and mediators of PA behavior. Population-specific measures that are current and contextually suitable for the intended audience have important implications for researchers. This is because instrument sensitivity is likely to be improved if measures and their items are deemed appropriate for the particular demographic being investigated.22

Methods

Development of Scales and Items

During the initial development of the scales a series of qualitative processes were employed.23 First, a review of the literature reporting the properties of existing social cognitive measures relating to adolescent PA was conducted. A preliminary instrument was then developed, comprising of 5 scales designed to be unidimensional measures of the following constructs from Bandura’s Social Cognitive Theory (SCT):24 perceived self-efficacy, situation (perceptions of the physical environment), behavioral strategies (self-control), social support and outcome expectations (perceived benefits) and expectancies (value placed on benefits) relating to PA. The SCT purports that behavior change is influenced by a complex interaction between personal and environmental factors, and attributes of the behavior itself.18 While many other models of health behavior are limited to predicting health behaviors, a strength of SCT lies within the provision of predictors and principles that lead to informing, guiding, enabling and motivating individuals to modify their behaviors in promoting good health.25 This may help to explain why SCT has emerged as a prominent health behavior model in guiding the development of interventions and examination of mechanisms of health behavior change in children and adolescents.20,26,27

In developing the measures, an objective was to include items that address the significant role that technology plays in the lives of contemporary adolescents.28 As such, several items refer to various modern technologies (eg, personal music devices, mobile phones, and pedometers), that may be used to support participation in PA and that research has shown are often accessible to and routinely used by many adolescents today.28,29 The relevance of such technology to youth PA has become more apparent in PA research in the past decade. Not only has there been increase in the number of PA interventions that have adopted the use of modern technological devices such as pedometers and mobile phones to encourage or motivate personal monitoring of PA, but there is growing evidence to support the success of these strategies in promoting PA.30–32

Three experts in PA, SCT, and scale development were consulted to review the measures and determine content validity. Specifically the experts were asked to a) examine how well each item contributed to the theoretical conceptualization of each construct, b) examine how well response options supported respective items, and c) evaluate item comprehension and the potential for participant burden.33

To further review and refine the scales, a focus group was conducted with 12 secondary school students (age 14.1 ± 0.6 years; females = 58%) in Spring 2009. Participants were randomly selected from a group of consenting students in Grades 8 and 9 from an independent (non-government) school. A semistructured interview setting was adopted where probing facilitated the examination of thought processes used in arriving at an answer and interpreting instruction sets and response options. The focus group was digitally recorded and transcribed.

To increase scale sensitivity, the number of Likert-type response options employed by each scale used no fewer than 4 response options.34 No neutral/uncertain response category was provided for any scale on the basis that this may lower questionnaire reliability through reducing variability.34 As such, scales ensured the provision of weak response categories (eg, slightly disagree/agree) in attracting students who would otherwise prefer a neutral option.

Self-Efficacy. Self-efficacy was operationalized as an individual’s confidence in personal ability to adopt and maintain PA behaviors and overcome barriers to PA. Eight items were measured on a 6-point Likert-type scale of 1 (strongly disagree) to 6 (strongly agree); for example, “I find it difficult to be physically active when I have no one to be active with.” The scale combined original and modified items from previous scales developed for older children35 and adolescents.36 For example, Motl’s36 earlier self efficacy measure included the item “I can be physically active during my free time on most days no matter how busy my day is,” which was abridged to read “I can still be physically active even when I’ve had a busy day.”

Situation. Eight items assessed an individual’s mental representation of their physical home/neighborhood and school environments which may influence their PA behaviors. Specifically, items examined how neighborhood safety and accessibility to facilities and equipment at home and school impact PA; for example, “It is difficult to be physically active in my neighborhood because of lots of traffic.” A 6-point Likert-type scale again examined the respondents’ level of agreement/disagreement with each item. Original items were merged with modified items from an earlier measure intended for older children.37

Social Support. Social support was operationalized as various supportive behaviors received from friends...
and family in the previous 3 months that encouraged participation in PA; for example, “... did members of your family take you to places where you could be physically active (for example, to the beach, sports training, or weekend sport?)”. Twelve items examined the frequency of supportive behaviors received using a 5-point Likert-type scale (1 = never, to 5 = always). Some items were modified versions from a previous scale that examined parent-reported correlates of child and adolescent PA.38

Behavioral Strategies. Eight items examined self-regulation strategies used to reinforce participation in PA, including methods used to enhance enjoyment, set goals and self-monitor PA behaviors. Two modified items from Dishman’s39 earlier measure intended for older children and adolescents were included. A 5-point Likert-type scale assessed the frequency (1 = never, to 5 = always) at which various self-regulation strategies were employed during the previous 3 months; for example, “Did you keep track of how much physical activity you did—for example, using a pedometer, timer on your phone or by keeping a log book?”

Outcome Expectations and Expectancies. Outcome expectations were operationalized as anticipated physical, social, and emotional benefits of being physically active. Eight items were rated on a 6-point Likert-type scale (1 = strongly disagree, to 6 = strongly agree); for example, “Participation in regular physical activity can help me to manage stress better.” Some expectation items were modified versions sourced from previous PA enjoyment and attitude scales developed for children and adolescents.41 Five outcome expectancy items provided a corresponding personal evaluation of the benefit identified by each outcome expectation item. Items were rated on a 4-point Likert-type scale (1 = not at all important, to 4 = very important); for example, “How important is managing stress to you?”

Questionnaire Administration

Following approval from the University Research Ethics Committee, consent was obtained from the Principals of 3 nongovernment schools from the Newcastle/Central Coast region of New South Wales for their school’s involvement in the questionnaire’s testing. Consenting secondary school-aged students from predominantly middle-class backgrounds were recruited from these schools to complete a 2-week test-retest in Autumn 2010.

Data Analyses

Descriptive statistics were obtained for all variables [Means (M), standard deviations (SD) and frequencies (f)] using SPSS 17.0. Since the percentage of missing data were very small (0.02%), mean substitution was the preferred imputation method used to manage incomplete data rather than exclusion methods.42

Reliability. Reliability analyses were conducted using SPSS 17.0. To provide a coefficient of individual repeatability, the 95% limits of agreement were calculated.43 Scores for the intertrial difference (T2 – T1) were plotted against the intertrial mean [(T1 + T2)/2] for each individual, after which the range of differences falling within the mean of the intertrial differences ± 1.96 standard deviations was calculated33,44. Bivariate correlations between the intertrial difference and the intertrial mean were also assessed to establish if the limits of agreement were consistent throughout the range of measurements. Cronbach’s alpha coefficient was calculated from T1 (baseline) data to estimate the internal consistency of each scale. Values > 0.6 are considered reliable.45 Finally, intraclass correlation coefficients (ICCs) were calculated to provide a measure of rank order repeatability. For each scale, an ICC score ≥0.75 indicates excellent reliability.46

Factor Analysis. Confirmatory factor analysis (CFA) using AMOS 17.0 was used to directly test model fit for each of the scales. The chi-square tests for statistically significant difference between the covariance matrix of the hypothesized model and the observed population variables.47 While a nonsignificant chi-square result (P > .05) indicates the model being examined is a good fit, it is often too sensitive to sample size and a rejection of the hypothesized model likely results.48 For this reason, additional measures should be used to examine model fit. Hence the following model-fit indices were calculated from baseline (T1) data: chi-square index, the root mean error of approximation (RMSEA), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI) and the comparative fit index (CFI). In interpreting GFI, AGFI and CFI scores; values ≥0.9, ≥0.95, or equal to 1 indicate adequate, good, and exact fit of the model, respectively.59 The RMSEA is widely regarded as a principal index in examining model fit,60 where scores ≤0.08, ≤0.06, and 0.0, signify acceptable, close, and exact fits, respectively.59 If data showed multivariate nonnormality (multivariate kurtosis represented by a Mardia’s coefficient > 3),51 the Bollen-Stine bootstrap procedure was employed to examine model fit and bias corrected regression coefficients are reported.52 CFA was also used to examine factor loadings for each item on its latent construct in determining scale homogeneity for each measure. Coefficients ≥0.45 are considered fair, while values ≥0.55 and ≥0.71 indicate a factor loading to be good and excellent respectively.53

Results

Descriptive Statistics

The study sample included 171 secondary school students (age = 13.6 ± 1.2; 61% female), comprising 80.1% Australian, 9.9% European, 3.5% Asian, 1.8% Middle Eastern, 1.2% African, and 3.5% other. A 1-way analysis of variance (ANOVA) revealed there were no statistically significant intertrial gender differences for any of the scales. Hence separate analyses by gender were not carried out. Scale means and standard deviations are presented in Table 1. Means ranged from 2.7 (±1.3) to 5.5 (±0.7) on the 6-point Likert-type scale for
the self-efficacy, situation and outcome expectations measures; 2.2 (±1.2) to 4.0 (±1.0) on the 5-point Likert-type scale for the social support and behavioral strategies measures; and 3.1 (±0.9) to 3.4 (±0.7) on the 4-point Likert-type scale for the outcome expectancy measure.

Confirmatory Factor Analysis

Self-Efficacy. Preliminary analyses revealed the original 8-item self-efficacy scale to show inadequate model-fit and requiring further refinement. An iterative process involving the removal of 1 item at a time found 3 items represented unacceptable factor loadings on the model, contributed poorly to model-fit indices and were considered redundant by other similarly worded items seeking the same information. Subsequently, Table 2 shows the final composite resulted in a 5-item 1-factor model where fit indices demonstrated good-to-exact fit, and factor loadings for items ranged from fair (0.45) to excellent (0.70).

Situation. Initially a 1-factor model resulted in a poor fit to the 8-item situation questionnaire. Further confirmatory analyses revealed a more robust scale was established when treated as a 2-factor model comprising of a home/neighborhood environment factor and school environment factor. Following the removal of 2 items which loaded poorly on the home/neighborhood structure, fit indices significantly improved for the final 2-factor model which demonstrated good fit and comprised item loadings that ranged from fair to excellent for the home/neighborhood (0.49–0.72) and school (0.52–0.73) factors respectively (Table 2).

Social Support. The original 12-item social support scale demonstrated poor model fit when treated as a 1-factor model. Analyses supported a 2-factor structure as items were categorized to either a friend or family factor, indicating from whom social support for being physically active was received. Following the removal of 2 items from each of the family and friend support subscales, the final 2-factor model showed an improved and parsimonious fit represented by adequate-to-good fit indices and item loadings that ranged from good to excellent for the friend (0.57–0.71) and family (0.62–0.73) support factors, respectively (Table 2). The final measures comprised 4 friend support items and 4 family support items.

Behavioral Strategies. The original 8 items loaded adequately on the 1-factor model, however, some fit indices proved less than satisfactory. Two items which contributed poorly to the scale’s psychometric properties and showed extreme kurtosis were removed. The resulting scale showed improved model fit, demonstrating adequate-to-good fit indices (Table 2) and good factor loadings which ranged from 0.55–0.70.

Outcome Expectations and Expectancies. Preliminary analyses showed model-fit for a paired 8-item expectations and expectancies measure did not satisfy all criteria. The removal of 3 expectations items, which loaded poorly on the expectations structure, resulted in a refined 5-item scale which satisfied most model-fit criteria and comprised good (0.50) to excellent (0.79) factor loadings (Table 2). The removal of the 3 corresponding expectancy items also improved model fit indices and factor loadings (ranging from 0.29–0.79) for the expectancy scale. Yet, poor values for the RMSEA and some factor loadings persisted, suggesting further refinement was needed. Additional confirmatory analyses revealed the removal of 1 pair of items, which provided a noninterpretable factor loading (< 0.30) on the expectancy scale, did improve and satisfy all model-fit indices and factor loadings. However a decision was made to retain the corresponding items because of the content representativeness value.

Reliability Analysis

Reliability results for the final questionnaires following item reduction are shown in Table 3. Bland-Altman analyses revealed narrow limits of agreement for each of the scales. Nonsignificant bivariate correlations between the intertrial difference and intertrial mean indicated the limits of agreement were consistent throughout the range of measures for all scales, except one (home/neighborhood situation scale). Intraclass correlation coefficients (ICCs) indicated very good rank-order repeatability, ranging from 0.82 for outcome expectations to 0.91 for the self-efficacy, family social support and behavioral strategies scales. Meanwhile, internal consistency coefficients were at least acceptable and ranged from 0.63 for the home/neighborhood situation subscale to 0.79 for the behavioral strategies scale.

Discussion

There is strong support for the influence of social cognitive factors on the PA behavior of children and adolescents. However, quality measures with strong psychometric properties are needed to improve our understanding of PA in these populations. The current study describes the development and evaluation of new scales for assessing social cognitive measures related to adolescent PA. While all scales demonstrated acceptable reliability, CFA was able to establish acceptable construct validity in supporting the scales utility for identifying potential correlates and mediators of adolescent PA.

Few comprehensive questionnaires that include several social cognitive measures have been developed and evaluated in adolescent populations. While a multitude of instruments for assessing social cognitive influences of PA exist, many scales comprise a large number of items. This may be problematic for the researcher(s) when more than 1 measure is of interest. For instance, lengthy questionnaires can be burdensome on respondents, which in turn may negatively impact instrument sensitivity and hence data accuracy. As such, improved and more parsimonious social cognitive measures of youth PA are needed.

A unique feature of these scales is the inclusion of novel items that assess modern technology’s potential
<table>
<thead>
<tr>
<th>Constructs and descriptions</th>
<th>Source of modified items</th>
<th>Range (No. of items)</th>
<th>T1 (baseline)</th>
<th>T2 (2-week retest)</th>
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</thead>
<tbody>
<tr>
<td><strong>Self efficacy:</strong> Participants were asked to rate their confidence in their ability to adopt and overcome barriers to PA behaviors</td>
<td>[34, 35]</td>
<td>1–6 (5)</td>
<td>4.2 ± 1.0</td>
<td>–1.09 to 0.11</td>
</tr>
<tr>
<td><strong>Scale:</strong> 1 = disagree a lot; 6 = agree a lot</td>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>Item Kurtosis</td>
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<tr>
<td><strong>Example:</strong> “When I’m physically active (eg, during PE or school sport) I get embarrassed about my fitness or skill level.”</td>
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<tr>
<td><strong>Situation:</strong> Participants were asked to respond to statements about their mental representation of the home/neighborhood and school physical environment that may influence their PA behavior.</td>
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<tr>
<td><strong>Scale:</strong> 1 = disagree a lot; 6 = agree a lot</td>
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<tr>
<td>a) <strong>Home/neighborhood example:</strong> “At home I have access to equipment that helps me to be physically active (eg, bikes, balls, skateboards).”</td>
<td>[36]</td>
<td>1–6 (3)</td>
<td>5.0 ± 0.9</td>
<td>–0.20 to 6.19</td>
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<tr>
<td><strong>Example:</strong> “At school, facilities are available during recess/lunch for me to be physically active (eg, the gym, dance studio, sports equipment).”</td>
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<tr>
<td>b) <strong>School example:</strong> “At school, facilities are available during recess/lunch for me to be physically active (eg, the gym, dance studio, sports equipment).”</td>
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<tr>
<td><strong>Behavioral strategies:</strong> Participants were asked to rate the frequency with which they reinforced their own PA behaviors through setting goals, self-monitoring and strategies for enhancing enjoyment, starting with the common stem “In the past 3 months how often . . . .”</td>
<td>[38]</td>
<td>1–5 (6)</td>
<td>3.2 ± 0.8</td>
<td>–0.78 to –0.19</td>
</tr>
<tr>
<td><strong>Scale:</strong> 1 = never; 5 = always</td>
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<tr>
<td><strong>Example:</strong> “. . . did you participate in a variety of physical activities to avoid boredom?”</td>
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<tr>
<td><strong>Social support:</strong> Participants were asked to rate the frequency with which friends and family reinforced PA through encouragement, role modeling, and the provision of PA opportunities, starting with the common stem “In the past 3 months how often . . . .”</td>
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<tr>
<td><strong>Scale:</strong> 1 = never; 5 = always</td>
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</tr>
<tr>
<td>a) <strong>Friend support example:</strong> “. . . did you make plans with your friends to be physically active together?”</td>
<td>[37]</td>
<td>1–5 (4)</td>
<td>3.1 ± 0.9</td>
<td>–0.89 to 0.81</td>
</tr>
<tr>
<td><strong>Family support example:</strong> “. . . did your parents buy you equipment that encouraged you to be physically active (eg, sports clothes, joggers, bike . . . .)”</td>
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<tr>
<td>b) <strong>Family support example:</strong> “. . . did your parents buy you equipment that encouraged you to be physically active (eg, sports clothes, joggers, bike . . . .)”</td>
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<td></td>
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<td>Mean ± SD</td>
<td>Item Kurtosis</td>
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(continued)
### Table 1 (continued)

<table>
<thead>
<tr>
<th>Constructs and descriptions</th>
<th>Source of modified items</th>
<th>Range (No. of items)</th>
<th>T1 (baseline)</th>
<th>T2 (2-week retest)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome expectations</strong>: Participants were asked to respond to statements about various benefits of PA</td>
<td>[39, 40]</td>
<td>1–6 (5)</td>
<td>5.2 ± 0.6</td>
<td>0.10 to 5.85</td>
</tr>
<tr>
<td><strong>Scale</strong>: 1 = disagree a lot; 6 = agree a lot</td>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>Item Kurtosis</td>
</tr>
<tr>
<td><strong>Example</strong>: “Participation in regular physical activity helps to improve my fitness.”</td>
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<tr>
<td><strong>Outcome expectancies</strong>: Participants were asked to rate personal value placed on each corresponding outcome expectation item for PA</td>
<td></td>
<td>1–4 (5)</td>
<td>3.2 ± 0.5</td>
<td>-0.74 to 0.81</td>
</tr>
<tr>
<td><strong>Scale</strong>: 1= not at all important; 4 = extremely important</td>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>Item Kurtosis</td>
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<tr>
<td><strong>Example</strong>: “How important is improving your fitness to you?”</td>
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</table>

*a Scale is presented as a 2-factor model.

Abbreviations: PE, physical education; PA, physical activity.
influence on the PA experiences of adolescents today. For example, in the social support scale, respondents were asked to consider equipment provided by parents that may encourage participation in PA and a reference to an ‘i-pod’ (iPod; personal music device) is provided in the prompts that follow the question: “. . . did your parents buy you equipment that encouraged you to be physically active? (eg, sport clothes, joggers, a bike, an i-pod for listening to music while being physically active)”. In a second example, the behavioral strategies scale includes an item that prompts respondents to consider if modern technological devices may assist personal monitoring of PA: “. . . did you keep track of how much physical activity you did (eg, by using a pedometer, timer on your mobile phone . . .)?”. To the authors’ knowledge, no similar measures intended for adolescents have included prompts addressing the potential for modern technology to support participation in PA. While such a feature supports a more contemporary set of measures, instrument sensitivity may also be improved especially when modern technological devices have become commonplace for many adolescents today.28,29

### Table 2  Validity Results of the Confirmatory Factor Analysis Showing Model Fit and Factor Loadings From Baseline Data

<table>
<thead>
<tr>
<th>Constructs</th>
<th>$\chi^2$</th>
<th>$P$</th>
<th>RMSEA</th>
<th>GFI</th>
<th>AGFI</th>
<th>CFI</th>
<th>Factor loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self efficacy</td>
<td>3.82</td>
<td>0.58</td>
<td>0.00</td>
<td>0.99</td>
<td>0.97</td>
<td>1.00</td>
<td>0.45–0.70</td>
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<tr>
<td>Situation(^a)</td>
<td></td>
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</tr>
<tr>
<td>Home/neighborhood</td>
<td>11.22</td>
<td>0.19</td>
<td>0.05</td>
<td>0.98</td>
<td>0.95</td>
<td>0.98</td>
<td>0.49–0.72</td>
</tr>
<tr>
<td>School</td>
<td>0.52–0.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavioral strategies</td>
<td>15.45</td>
<td>0.16</td>
<td>0.07</td>
<td>0.97</td>
<td>0.93</td>
<td>0.97</td>
<td>0.55–0.70</td>
</tr>
<tr>
<td>Social support(^a)</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Friend support</td>
<td>27.40</td>
<td>0.10</td>
<td>0.05</td>
<td>0.97</td>
<td>0.93</td>
<td>0.98</td>
<td>0.57–0.71</td>
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<tr>
<td>Family support</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>0.62–0.73</td>
</tr>
<tr>
<td>Outcome expectations</td>
<td>11.26</td>
<td>0.05</td>
<td>0.09</td>
<td>0.97</td>
<td>0.92</td>
<td>0.97</td>
<td>0.50–0.79</td>
</tr>
<tr>
<td>Outcome expectancies</td>
<td>15.74</td>
<td>0.01</td>
<td>0.11</td>
<td>0.97</td>
<td>0.90</td>
<td>0.91</td>
<td>0.29–0.79</td>
</tr>
</tbody>
</table>

\(^a\) Scale is presented as a 2-factor model.

Abbreviations: $\chi^2$, chi-square; RMSEA, root mean square error of approximation; GFI, goodness of fit index; AGFI, adjusted goodness of fit index; CFI, comparative fit index.

### Table 3  Reliability Results: Bivariate Correlations, 95% Limits of Agreement, Test-Retest Stability, and Internal Consistency

<table>
<thead>
<tr>
<th>Constructs</th>
<th>$R^b$</th>
<th>95% limits of agreement</th>
<th>ICC (95% CI)</th>
<th>Cronbach’s alpha(^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self efficacy</td>
<td>0.03</td>
<td>–1.14 to 1.02</td>
<td>0.91 (0.88–0.93)</td>
<td>0.69</td>
</tr>
<tr>
<td>Situation(^a)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Home/neighborhood</td>
<td>–.18*</td>
<td>–1.12 to 1.07</td>
<td>0.88 (0.83–0.91)</td>
<td>0.63</td>
</tr>
<tr>
<td>School</td>
<td>0.08</td>
<td>–1.45 to 1.29</td>
<td>0.85 (0.79–0.89)</td>
<td>0.65</td>
</tr>
<tr>
<td>Behavioral strategies</td>
<td>–0.03</td>
<td>–0.81 to 0.97</td>
<td>0.91 (0.88–0.93)</td>
<td>0.79</td>
</tr>
<tr>
<td>Social support(^a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friend support</td>
<td>–0.12</td>
<td>–1.12 to 1.13</td>
<td>0.86 (0.81–0.90)</td>
<td>0.74</td>
</tr>
<tr>
<td>Family support</td>
<td>–0.12</td>
<td>–0.79 to 1.04</td>
<td>0.91 (0.88–0.94)</td>
<td>0.78</td>
</tr>
<tr>
<td>Outcome expectations</td>
<td>–0.15</td>
<td>–0.77 to 0.95</td>
<td>0.82 (0.75–0.86)</td>
<td>0.75</td>
</tr>
<tr>
<td>Outcome expectancies</td>
<td>–0.05</td>
<td>–0.54 to 0.72</td>
<td>0.88 (0.83–0.91)</td>
<td>0.66</td>
</tr>
</tbody>
</table>

\(^a\) Scale is presented as a 2-factor model; \(^b\) Bivariate correlations between the difference (T2 – T1) and the mean [(T1 + T2)/2]; \(^c\) Cronbach’s alpha calculated from baseline (T1) data; *$P < .05$; 95% limits of agreement calculated as the intertrial mean difference ± 1.96 SDs (of the intertrial difference).

Abbreviations: ICC, intra class correlation; CIs, confidence intervals.
In comparing psychometric properties of the presented scales with those reported by similar measures, some challenges were observed. Firstly, while CFA was found to be a popular approach for examining the construct validity of other social cognitive measures, considerable variation in the model-fit indices reported have made comparisons between studies problematic. Clearly a set of universally agreed upon standards for examining and reporting model-fit need to be established. Regardless, CFA demonstrated each of the current measures to represent good-to-excellent construct validity as shown by acceptable model-fit indices and factor loadings.

Secondly, the author’s found the internal consistency reliability (Cronbach’s $\alpha$) of earlier measures to be frequently provided, yet few to report ICC values to indicate scale stability. Rather, Pearson correlation coefficients are more commonly reported to inform consistency between test and retest scores. Yet, their use to report stability of data has been regarded inappropriate and flawed because a relation between test and retest scores is merely provided. In contrast, ICCs examine agreement, between scores within individuals, and so are considered a more suitable assessment of instrument stability.

**Self Efficacy Scale**

Bandura’s has proposed that self-efficacy is the central determinant of SCT because it influences health behavior both directly and indirectly through its effect on the other behavioral determinants. Beyond this premise, there is strong empirical support for self-efficacy as a correlate of child and adolescent PA and more recently evidence for self efficacy as a potential mediator of PA behavior change in adolescent intervention studies has developed.

Our findings support a valid and reliable measure of self-efficacy. The 5-item single factor structure represents a more parsimonious measure than previous self-efficacy scales which have comprised up to 17 items and 3 factors.

With regards to CFA, where direct comparisons can be made through reporting of common fit-indices (RMSEA and CFI), our findings have improved upon results of several earlier self-efficacy measures. A further strength of the present self efficacy scale has seen all items load adequately on the 1-factor model. While the authors found few previous self-efficacy measures to report item factor loadings, earlier measures have reported items that have loaded inadequately ($< 0.45$) on the hypothesized model without providing argumentative support for doing so. It has been suggested that retaining items that load poorly on a latent construct can compromise questionnaire homogeneity.

**Situation Scale**

While individual correlates of PA (eg, self efficacy, enjoyment, and intentions) have been reported to account for up to 40% of the predicted variance in PA behavior only, there has been increasing interest in the role various aspects of the environment (eg, physical, social, and cultural) may play in facilitating or impeding PA behavior.

While the environment is a key construct within SCT hypothesized to influence individual behavior change, there is strong support for various aspects of the environment, including the physical (eg, access to facilities and opportunities that promote PA) to correlate with the PA behaviors of children and adolescents.

While few previous measures assessing barriers and facilitators of adolescent PA have been place-specific, the present situation measure examined the perceived physical features of specific environments (home/neighborhood and school) that may promote or impede opportunities for PA. While local neighborhoods and parks have been highlighted in the literature as key locations used by adolescents for PA, important associations between the school environment and student PA levels have also been established.

Results indicated the 2-factor situation scale to demonstrate favorable construct validity and reliability. While several earlier measures of the physical environment and its relation to PA do exist, variability in content does make comparisons of psychometric results perhaps futile. For example, where earlier questionnaires examine PA facilitators or impediments of the neighborhood environment only the current single-factor home/neighborhood situation scale assesses both the home and neighborhood environments. Similarly, different information is sourced from Robertson-Wilson’s earlier measure of the school environment which extends the current single-factor subscale assessing the school environment by investigating physical features of physical education classes, school and intramural sport opportunities. Even so, the present measure may offer researchers a more parsimonious scale that still is capable of examining 3 physical environments within a concise 2-factor structure.

**Social Support Scale**

Social support for PA is another environmental variable that has received widespread attention for its potential influence on PA behaviors. While there is good evidence for parent and peer support to correlate with the PA behaviors of children and adolescents, the important influence family support may provide has begun to materialize with recent reviews revealing the most efficacious school-based PA programs have integrated a familial component.

The current social support scale comprised a 2-factor model assessing friend and family support for PA. Where common fit indices are reported (RMSEA and CFI), present model-fit results are analogous with previous results from a similar social support measure. Although stability reliability for the family (ICC = 0.91) and friend support (ICC = 0.86) subscales were higher than coefficients reported by Norman and colleagues for an earlier family support (ICC = 0.74) and peer support (ICC = 0.68) measure, a comparison of internal consistency revealed marginal difference between the respective measures.
Behavioral Strategies Scale

The behavioral strategies scale was found to be reliable measure with good construct validity. Although personal regulation of behavior through strategy use is hypothesized to be a primary mechanism for behavior change in several theories of health behavior, there is little empirical evidence available to support such an assumption. Specifically, very few studies have examined the role self-management strategies may play as a potential mediating variable of PA behavior change in youth interventions\(^{20,21}\) and so strong conclusions cannot be formed. More research is needed in this area, and valid and reliable measures examining self-management strategies for PA are necessary to facilitate this research.

Although the present measure demonstrated sound construct validity, common model fit indices (RMSEA and CFI) were marginally inferior to earlier reports for self-management scales that assessed behavioral and cognitive strategies among adolescent girls.\(^{39,70}\) Both prior studies evaluated scales that were adaptations of a measure initially developed for adults.\(^{56}\) The internal consistency reliabilities of our scale compared both favorably\(^ {39}\) and less favorably\(^ {68}\) to earlier measures. Although the authors found very few comparable measures to report ICC values, the present measure (ICC = 0.91) did represent stronger instrument stability than Norman’s\(^ {68}\) scale (ICC = 0.75). However, while a comparison of psychometric properties have been made, it should be noted that content varies between established measures of self-management strategies for PA. For example Norman’s\(^ {68}\) single-factor scale examined cognitive and behavioral strategies, and was specifically developed to reflect content of an intended intervention.

Outcome Expectations and Expectancies Scale

Refinement following preliminary analyses resulted in a reduced 5-item outcome expectations questionnaire which assessed perceived physical, social and psychological benefits of PA, and included corresponding expectancy items examining personal evaluations of each benefit. A primary consideration was to develop a questionnaire that addressed PA benefits relevant to adolescents. Contento and colleagues\(^ {71}\) suggest knowledge of long-term health outcomes do little to motivate adolescent food choices because the ramifications may be perceived as remote and inconsequential. While the same may be true for adolescent motivations that drive participation in PA, the current scale focused more on potential immediate or short-term benefits such as fitness, enjoyment, and socialization rather than potential long-term health implications.

Although most fit indices for the expectations/expectancy subscales were adequate to good, weak RMSEA values (> 0.08) suggest further scale refinement may contribute to a more robust model. In particular, 1 pair of items proved problematic. Although the expectation statement (“Participation in regular physical activity can help me to control my weight better”) loaded adequately on its factor structure (0.55), this was not true for the corresponding expectancy statement (“How important is controlling your weight to you?”), which loaded poorly (0.29) on its respective structure. However, a decision was made to retain the paired items, arguing that the content was particularly relevant to the construct being measured.

Although reliability results demonstrated adequate-to-good internal consistency for the expectancy and expectations subscales respectively, values were poorer than those reported by Dishman and colleagues\(^ {39,70}\) for earlier expectancy measures, yet improved upon values reported in a validation sample\(^ {40}\) for a similar scale. Further, the current questionnaire is a more parsimonious and coherent single factor measure than Saunders’s\(^ {40}\) 2-factor 16-item belief scale. Although ICC values are not reported by these previous studies to allow a comparison of scale stability, the present expectation and expectancy measures demonstrated a high degree of test-retest reliability (ICC = 0.82 and 0.88, respectively).

Implications

A developing body of literature has highlighted the potential influence of social cognitive factors such as self-efficacy, social support, and behavioral strategies on adolescent PA.\(^ {20,38,54}\) However, it has been suggested that the measurement of such influences has been problematic and may have contributed to inaccurate conclusions regarding correlates or the most effective mediators of PA.\(^ {21}\) More specifically, it’s important that measures used by researchers for this purpose exhibit acceptable reliability and validity.

The current study has demonstrated evidence for the construct validity and reliability of 5 scales designed to measure SCT constructs related to PA in adolescents. The authors believe this questionnaire provides a contemporary and parsimonious solution for researchers interested in more than 1 social cognitive measure relating to PA behavior in this population.

Despite the strengths of this study, there are some limitations that should be noted. The tests of validity used in the current study were not extensive. Future researchers are encouraged to test the concurrent and convergent validity of these scales by comparing them with similar validated measures and actual PA behavior. Furthermore, although the study’s sample size is comparable to many other validation studies, it may present as a limitation for additional factor analytical techniques that could be carried out; for example, 1) cross validation of the measurement models by employing a multigroup analysis (eg, between different races and populations) of factorial invariance, and 2) testing for longitudinal factorial invariance of the measurement models across time. Focus group participants were adolescents from 1 low-fee paying independent secondary school and therefore might not be representative of a diverse population of adolescents. Finally, although the racial/ethnic
demographics of the study sample were fairly well representative of Australia,72,73 the sample nevertheless was relatively homogenous; additional testing of the measures in multiethnic populations is advised.

Conclusions

The results of this study provide support for the construct validity and reliability of modernized social cognitive measures assessing: perceived self-efficacy, situation (including a home/neighborhood factor and school factor), behavioral strategies, social support (including a friend factor and family factor), and outcome expectations and expectancies related to PA for use among an adolescent population. As such, these scales are suitable for the identification of potential social cognitive correlates of youth PA, mediators of PA behavior changes and the testing of theoretical models based on SCT.

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References


