Validity and reliability of the Parental Sun Protection Scales

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Abstract

Skin cancer is the most common cancer diagnosed in the US and its incidence continues to rise. Epidemiological studies have shown that excessive sun exposure received during childhood may increase the risk of developing skin cancer later in life. Yet, there are few published reports on the development of reliable and valid theory-based scales that assess the factors associated with parental sun-protection practices to reduce sun exposure in preschool children. To fill this gap, the Parental Sun Protection Scales were developed and validated. Two series of confirmatory factor analytic models were employed to test the factor structure of the scales and to examine the interrelationships among the proposed psychosocial factors. Sunscreen-use and sun-avoidance behavioral models were tested in a sample of 384 parents. The results provided a basis for the reliable and valid measurement of psychosocial factors related to parental sun-protection practices. These scales may be useful in more fully understanding the determinants of sun-protection behaviors and in evaluating intervention programs designed to improve such behaviors.

Introduction

The incidence of skin cancer continues to rise, with approximately 51,400 cases of melanoma and over a million cases of non-melanoma skin cancers expected in 2001 (Greenlee et al., 2001). Melanoma is the most fatal skin cancer and an estimated 7800 melanoma-related deaths are expected in 2001 (Greenlee et al., 2001). Residence in geographic areas with high levels of ambient UV radiation in childhood may increase the risk of developing melanoma later in life (Holman and Armstrong, 1984; Khlat et al., 1992). Excessive sun exposure, i.e. frequent and severe sunburns, during childhood may increase the risk of developing melanoma (Zanetti et al., 1992; Rodenas et al., 1996), basal cell carcinoma (Hunter et al., 1990; Gallagher et al., 1995a) and squamous cell carcinoma (Gallagher et al., 1995b). Thus, childhood is a significant period for reducing skin cancer risk and caregiver practices to reduce sun exposure in children are an important focus of study.

To evaluate theory-based sun-protection interventions designed to reduce sun exposure in children, it is important to construct valid and internally consistent measures of sun-protection behavior and related psychosocial variables. Reliable behavioral scales (Buller et al., 1995; Rodrigue et al., 1996; Parrott et al., 1999; Glanz et al., 1999), and psychosocial scales assessing outcome expectancy (Parrott et al., 1999), self-efficacy (Rodrigue et al., 1996; Parrott et al.,...
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1999), norms (Glanz et al., 1999), benefits (Glanz et al., 1999), barriers (Rodrigue et al., 1996; Buller et al., 2000), and perceived risk and severity (Rodrigue et al., 1996) have been reported in studies of recreation center staff, coaches and parents. Although measures of scale reliability are critical for evaluating research, less attention has focused on the construct validation of theory-based scales. Further, there is very little information on the reliability and validity of instruments designed to assess the sun-protection practices and related psychosocial factors of parents of young children.

Thus, the aim of the present study was to examine the construct validity and internal consistency reliability of scales based on Social Cognitive Theory (SCT) (Bandura, 1986) and developed for use in assessing psychosocial factors associated with sun-protection practices used by parents to reduce their young children’s sun exposure. This instrument will be used in the evaluation of a preschool sun protection education program, Sun Protection is Fun!, designed by the research team to impact several specific determinants of parental sun-protection practices (e.g. self-efficacy, impediments and expectancies). The program is described in detail elsewhere (Tripp et al., 2000). Construct validity of the scales was assessed by a confirmatory factor analysis of the hypothesized factor structure of the psychosocial scales. Additional evidence of validity was sought by examining the associations between the psychosocial scales and the behavioral scales of interest.

Methods

Instrument development

The Sun Protection is Fun! program was based on intervention methods suggested by SCT (Bandura, 1986), such as vicarious learning, symbolic modeling, enactive mastery experiences and persuasion. Thus, the research team grounded development of the Parental Sun Protection Scales (PSPS) in SCT, and central constructs represented in the scales include self-efficacy, expectancies and impediments as they relate to sunscreen use and sun avoidance. Behavioral and psychosocial items covered a range of protective behaviors including dressing children in protective clothing (e.g. wide-brimmed hats, sleeved shirts, and knee-length shorts); encouraging children to play in shaded areas; limiting children’s time spent outside during peak sun hours (11 a.m. to 4 p.m.); applying sunscreen with a sun-protection factor (SPF) of 15+ to children 30 min before they go outside; and reapplying SPF 15+ sunscreen to children after 1.5–2 h outside or after swimming (McDonald, 1998; American Cancer Society, 1999).

At the time of scale development, a review of the literature revealed very few studies of theoretical determinants of parental sun-protection behavior to reduce sun exposure among children. To identify any potentially related factors other than those suggested by SCT and to more fully understand the SCT constructs as they apply to sun protection in this population, the research team conducted focus group discussions in 1996 with parents of children enrolled in four preschools that were not participating in the study. In particular, discussions revealed that parents perceived impediments to providing sun protection, did not feel confident that they could use appropriate sun-protection strategies and did not perceive positive norms of sun protection.

The research team developed the PSPS by Intervention Mapping (Bartholomew et al., 1998). In this approach, performance objectives reflect the steps required to perform a behavior (e.g. dressing children in protective clothing) and so more specifically describe what the target population would do as a result of the sun-protection education program. If a theoretical factor was considered important in influencing a particular performance objective, then the research team developed a learning objective that reflected the most immediate target for change by the intervention (Bartholomew et al., 1998). These objectives guided development of the items on the psychosocial scales. A review of the skin cancer prevention literature ensured that items represented appropriate dimensions of the recommended preventive behaviors. After a
pool of items was generated to measure the constructs of interest, experts in SCT reviewed each item and judged whether it corresponded to the intended construct. Items were revised if necessary.

After content validity was assessed, the resulting 108-item survey was pilot-tested in a sample of 166 parents from four preschools outside of the study population. Items were retained if they exhibited good psychometric properties as suggested by item characteristics, item–scale correlations and internal consistency reliability. The resulting baseline survey consisted of 59 items. In an attempt to minimize response set bias, when possible, items representing the same construct were not placed next to each other in the format of the survey. For example, the common response scale format shared by the expectancy, norms and impediment items enabled the research team to mix these items. Likewise, items addressing sunscreen use and sun avoidance were alternated when possible.

Responses to the items dealing with the psychosocial scales of norms, expectancies and impediments were based on a five-point Likert scale ranging from strongly disagree to strongly agree. Responses to items on the self-efficacy scale ranged from not at all confident to extremely confident. Items assessing sunscreen-use and sun-avoidance behavior were constructed with a five-point Likert scale response format, from always to never. The sunscreen-use scale consisted of six items regarding application and reapplication of sunscreen to children. Sample items included, ‘I reapply sunscreen to my child every 1.5–2 hours after he/she has gone outside’ and ‘I take canopies or umbrellas along on outdoor activities so that I can set up shaded areas’.

Conceptual models
The confirmatory factor analytic models were based primarily on theory, although focus groups and pilot testing were conducted to examine the meaningfulness of particular items. Because we grounded scale development in SCT, we could specify the factor structure consistent with this theory (e.g. self-efficacy, impediments, norms and expectancies considered as distinct constructs) and proceed with confirmatory factor analysis. The conceptual models of the baseline survey instrument are presented in Figures 1 and 2. The items hypothesized to measure each of the constructs are included in rectangular boxes and connected to the related construct by a single arrow. Because the psychosocial factors are clustered around specific sun-protection behaviors, it was hypothesized that the factors would be correlated to each other, as represented by the double arrows.

The first series of models, referred to as sunscreen-use models (Figure 1), examined the psychometric properties of the items addressing sunscreen application and reapplication. In the sunscreen-use model, four inter-related psychosocial factors of sunscreen use were hypothesized: sunscreen-use self-efficacy, norms about sunscreen use, sunscreen-use expectancies and impediments to sunscreen use. The second series of models, referred to as sun-avoidance models (Figure 2), examined items related to sun avoidance (e.g. limiting time of exposure, dressing in protective clothing and encouraging use of shade). In this more general model, four inter-related psychosocial factors of sun avoidance were hypothesized: sun-avoidance self-efficacy, norms about sun avoidance, tanning expectancies and sun-avoidance expectancies.

Data collection
This research was reviewed and approved by the institutional review boards at The University of Texas M. D. Anderson Cancer Center and The
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Fig. 1. Initial conceptual model of sunscreen use.
Fig. 2. Initial conceptual model of sun avoidance.
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University of Texas–Houston Health Science Center. The PSPS were administered at summer’s end, 1996, to 572 parents whose children were enrolled in the 20 preschools participating in the evaluation of the Sun Protection is Fun! program and who had signed a consent form. Because the research team did not have contact information for parents, these baseline surveys were delivered to the preschools for parents to pick up from either the teacher or the child’s storage space. The investigators requested that parents return the completed survey to the preschool or mail it to the study center using the provided business reply envelope. Two sets of reminder postcards and additional copies of the survey were given to parents to increase the response rate.

Data analysis

The associations between the 42 psychosocial items and the presence of missing data (56 of the 384 respondents did not respond to all items) were examined. The number of valid responses was significantly associated with four of the items (0.10 < r < 0.15; P < 0.05). Given that the percentage of significant observed correlations was close to the percentage to be expected by chance alone and that the significant correlations were very small in magnitude, we used a recommended procedure for listwise deletion of missing data in all further analyses (Jaccard and Wan, 1996).

When there is a plausible theoretical structure for an instrument, as in our study, employing (theory-based) confirmatory factor analysis is less likely to produce the ambiguities often associated with (data-driven) exploratory factor analytic techniques; thus, the former is the preferred procedure in such cases (Bollen, 1989). Consequently, two series of four-factor (SCT-guided) confirmatory factor analytic models were employed to test the factor structure of the PSPS and to examine the inter-relationships among the proposed psychosocial factors. Because the survey was constructed to measure objectives developed specifically for the Sun Protection is Fun! program and the scale items were not adapted from other sources, a cross-validation strategy was used to test the conceptual models. This minimized the possibility that the models would be data-specific and not generalizable (Hoyle and Panter, 1995). For each model, a random subsample of 200 cases was selected and tested in the cross-validation stage of the confirmatory factor analyses.

Though measures of effect size are not biased due to the presence of within-group correlations, or alternatively described, intra-school correlations, even very small intra-school correlations may have substantial impact on tests of significance when model predictors (or covariates) are constrained to vary only at the school level (Murray, 1998; Carvajal et al., 2001). For the current analysis, there are no group-level predictors or covariates because we used only survey instrument variables (that vary by individuals within schools). Thus, the impact of even potentially large intra-class correlations for health behavior studies would be negligible with respect to assessing the magnitude of associations between variables or testing for significance (Murray, 1998; Carvajal et al., 2001).

Because the instrument would be used in the evaluation of a program designed to impact several specific determinants, the initial sunscreen-use and sun-avoidance models were modified according to SCT, with efforts to maintain the four hypothesized underlying factors. However, all modifications were made with empirical justification. Items with factor loadings of less than 0.30 (Tabachnick and Fidell, 1989) or many cross-loadings, i.e. a significant Lagrange Multiplier (LM) test (Bentler, 1990), or both, were omitted. Such undesirable psychometric properties may be due to potentially ambiguous item wording or to a non-hypothesized path between an item and a factor. Correlated error terms were added between items when item associations were not explained entirely by a common factor. A significant LM test provided empirical support for allowing correlated error terms. Such incomplete explanations may be due to item wording that suggests an underlying psychosocial construct further distinguishing pairs of items from their hypothesized factor or to wording suggestive of a more specific construct than that represented by the factor.
All models were tested with the statistical program EQS (Bentler, 1995). Because none of the survey items exhibited severely or even moderately high estimates of non-normality (skewness < 2; kurtosis < 7), procedures for maximum likelihood estimation were selected (West et al., 1995). Because of the data characteristics and the modeling procedures employed, goodness of fit was examined primarily by using the comparative fit index (CFI), the root mean square error of approximation (RMSEA) and an analysis of the standardized residuals (Jaccard and Wan, 1996). A CFI > 0.9 suggested a good model fit (Bentler, 1990); an RMSEA < 0.08, an adequate fit; an RMSEA < 0.05, a very good fit (Browne and Cudeck, 1993). Additionally, Akaike’s Information Criteria (AIC) (Akaike, 1987), the consistent version of the AIC (CAIC) (Bozgodan, 1987) and RMSEA were compared to evaluate the superiority of multiple models in the model modification stage of the analyses. Lower values on these indices suggested the more likely replication or better fit of a model. The CAIC value, as compared with the AIC, indicates model parsimony (Bollen, 1989); the RMSEA balances model parsimony with explanatory power.

Coefficient α (Cronbach, 1951) was determined for each scale to provide information on internal consistency reliability: α > 0.60 reflects modest internal consistency and α > 0.70 is generally considered to reflect good internal consistency for research purposes (Nunnally, 1978). The coefficient α provides evidence for scale internal consistency, though confirmatory factor analytic models can provide further evidence of the unidimensionality or homogeneity of a scale (Schmitt, 1996). This distinction between psychometric properties is important because the adjustment of statistical relationships among scales based on more traditional estimates of reliability (e.g. coefficient α) without also providing evidence for unidimensionality can lead to overestimation of the true strength of the underlying relationship.

In addition to the analyses described above, convergent validity was determined by examining the associations between the hypothesized psychosocial factors and scales measuring the behaviors of interest (e.g. sunscreen-use strategies and sun-avoidance strategies). Higher levels of sunscreen-use self-efficacy, more favorable norms and expectancies related to sunscreen use, and a lack of perceived impediments to sunscreen use were expected to correspond to higher levels of sunscreen use. Likewise, higher levels of sun-avoidance self-efficacy, more favorable norms and expectancies related to sun avoidance, and more unfavorable expectancies related to tanning were expected to correspond to higher levels of sun exposure avoidance.

Results

Description of respondents

Of the 572 parents sent the cross-sectional survey, 384 parents completed it for an overall response rate of 67%. Eleven of the 20 preschools had response rates of at least 70%, six had rates of 50–70% and three had response rates of less than 50%. The mean age of the 384 respondents was 32 years (SD = 6.2) and most were female (91%). The majority of respondents (62%) were Caucasian, 22% were African-American, 14% were Hispanic, and 1% were Asian. Educationally, 97% of respondents had at least a high school education and 82% had education beyond high school.

Descriptive statistics

The mean score (± SD), skewness and kurtosis for responses to each item in the initial sunscreen-use model and sun-avoidance model were determined (Tables I and II). Higher scores reflected more desirable levels of the constructs. For the sunscreen-use model, the distribution of scores of most items was near normal, except for four items (ScE1, ScE4, ScE5 and ScE6) that exhibited moderately negative skewness. Likewise, for the sun-avoidance model, only four of the 20 items (SAE1, SAE2, SAE3 and SAE5) exhibited moderately negative skewness. The scores of the other items were reasonably normally distributed.

Because a significant association between study variables is a prerequisite for applying all structural
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Table I. Descriptive statistics on sunscreen-use items

<table>
<thead>
<tr>
<th>Item</th>
<th>Range</th>
<th>M (SD)</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>ScSE1</td>
<td>1–5</td>
<td>3.68 (1.04)</td>
<td>−0.40</td>
<td>−0.39</td>
</tr>
<tr>
<td>ScSE2</td>
<td>1–5</td>
<td>3.44 (0.99)</td>
<td>−0.05</td>
<td>−0.51</td>
</tr>
<tr>
<td>ScSE3</td>
<td>1–5</td>
<td>3.23 (0.97)</td>
<td>0.10</td>
<td>−0.46</td>
</tr>
<tr>
<td>ScSE4</td>
<td>1–5</td>
<td>3.66 (1.01)</td>
<td>−0.29</td>
<td>−0.46</td>
</tr>
<tr>
<td>ScSE5</td>
<td>1–5</td>
<td>3.59 (0.97)</td>
<td>−0.25</td>
<td>−0.25</td>
</tr>
<tr>
<td>NSc1</td>
<td>1–5</td>
<td>3.40 (0.77)</td>
<td>−0.13</td>
<td>0.48</td>
</tr>
<tr>
<td>NSc2</td>
<td>1–5</td>
<td>3.55 (0.76)</td>
<td>−0.31</td>
<td>0.31</td>
</tr>
<tr>
<td>NSc3</td>
<td>1–5</td>
<td>3.15 (0.94)</td>
<td>−0.18</td>
<td>0.11</td>
</tr>
<tr>
<td>NSc4</td>
<td>1–5</td>
<td>3.62 (0.92)</td>
<td>−0.31</td>
<td>−0.34</td>
</tr>
<tr>
<td>NSc5</td>
<td>1–5</td>
<td>3.44 (0.83)</td>
<td>−0.25</td>
<td>−0.10</td>
</tr>
<tr>
<td>NSc6</td>
<td>1–5</td>
<td>3.39 (0.84)</td>
<td>−0.16</td>
<td>−0.01</td>
</tr>
<tr>
<td>ScE1</td>
<td>1–5</td>
<td>4.24 (0.97)</td>
<td>−1.84</td>
<td>3.68</td>
</tr>
<tr>
<td>ScE2</td>
<td>1–5</td>
<td>3.66 (0.87)</td>
<td>−0.72</td>
<td>−0.11</td>
</tr>
<tr>
<td>ScE3</td>
<td>1–5</td>
<td>3.86 (0.69)</td>
<td>−0.65</td>
<td>1.13</td>
</tr>
<tr>
<td>ScE4</td>
<td>1–5</td>
<td>4.08 (0.73)</td>
<td>−0.95</td>
<td>2.02</td>
</tr>
<tr>
<td>ScE5</td>
<td>1–5</td>
<td>4.23 (0.77)</td>
<td>−1.33</td>
<td>2.87</td>
</tr>
<tr>
<td>ScE6</td>
<td>1–5</td>
<td>4.03 (0.74)</td>
<td>−1.14</td>
<td>2.84</td>
</tr>
<tr>
<td>ISc1</td>
<td>1–5</td>
<td>3.38 (0.70)</td>
<td>−0.06</td>
<td>−0.79</td>
</tr>
<tr>
<td>ISc2</td>
<td>1–5</td>
<td>1.80 (0.78)</td>
<td>1.07</td>
<td>1.64</td>
</tr>
<tr>
<td>ISc3</td>
<td>1–5</td>
<td>2.34 (1.01)</td>
<td>0.56</td>
<td>−0.56</td>
</tr>
<tr>
<td>ISc4</td>
<td>1–5</td>
<td>2.49 (1.05)</td>
<td>0.42</td>
<td>−0.76</td>
</tr>
<tr>
<td>ISc5</td>
<td>1–5</td>
<td>2.57 (1.08)</td>
<td>0.37</td>
<td>−0.64</td>
</tr>
</tbody>
</table>

Table II. Descriptive statistics on sun-avoidance items

<table>
<thead>
<tr>
<th>Item</th>
<th>Range</th>
<th>M (SD)</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>SASE1</td>
<td>1–5</td>
<td>3.54 (1.01)</td>
<td>−0.19</td>
<td>−0.45</td>
</tr>
<tr>
<td>SASE2</td>
<td>1–5</td>
<td>3.33 (0.88)</td>
<td>0.13</td>
<td>−0.38</td>
</tr>
<tr>
<td>SASE3</td>
<td>1–5</td>
<td>3.26 (0.91)</td>
<td>0.15</td>
<td>−0.38</td>
</tr>
<tr>
<td>SASE4</td>
<td>1–5</td>
<td>3.43 (0.87)</td>
<td>0.20</td>
<td>−0.19</td>
</tr>
<tr>
<td>SASE5</td>
<td>1–5</td>
<td>3.34 (0.84)</td>
<td>0.08</td>
<td>0.05</td>
</tr>
<tr>
<td>NSA1</td>
<td>1–5</td>
<td>3.82 (0.77)</td>
<td>−0.59</td>
<td>0.88</td>
</tr>
<tr>
<td>NSA2</td>
<td>1–5</td>
<td>3.88 (0.71)</td>
<td>−0.73</td>
<td>1.73</td>
</tr>
<tr>
<td>NSA3</td>
<td>1–5</td>
<td>3.26 (1.02)</td>
<td>−0.07</td>
<td>−0.67</td>
</tr>
<tr>
<td>NSA4</td>
<td>1–5</td>
<td>3.50 (0.85)</td>
<td>−0.29</td>
<td>0.05</td>
</tr>
<tr>
<td>NSA5</td>
<td>1–5</td>
<td>2.85 (1.03)</td>
<td>0.29</td>
<td>−0.91</td>
</tr>
<tr>
<td>TnE1</td>
<td>1–5</td>
<td>3.02 (1.16)</td>
<td>−0.34</td>
<td>−0.89</td>
</tr>
<tr>
<td>TnE2</td>
<td>1–5</td>
<td>3.08 (1.13)</td>
<td>−0.40</td>
<td>−0.74</td>
</tr>
<tr>
<td>TnE3</td>
<td>1–5</td>
<td>2.49 (0.99)</td>
<td>0.25</td>
<td>−0.54</td>
</tr>
<tr>
<td>TnE4</td>
<td>1–5</td>
<td>1.81 (0.81)</td>
<td>1.08</td>
<td>1.70</td>
</tr>
<tr>
<td>TnE5</td>
<td>1–5</td>
<td>2.26 (0.94)</td>
<td>0.40</td>
<td>−0.37</td>
</tr>
<tr>
<td>SAE1</td>
<td>1–5</td>
<td>4.32 (0.88)</td>
<td>−1.59</td>
<td>2.80</td>
</tr>
<tr>
<td>SAE2</td>
<td>1–5</td>
<td>4.21 (0.76)</td>
<td>−1.09</td>
<td>1.96</td>
</tr>
<tr>
<td>SAE3</td>
<td>1–5</td>
<td>4.04 (0.74)</td>
<td>−1.08</td>
<td>2.41</td>
</tr>
<tr>
<td>SAE4</td>
<td>1–5</td>
<td>3.81 (0.70)</td>
<td>−0.57</td>
<td>0.58</td>
</tr>
<tr>
<td>SAE5</td>
<td>1–5</td>
<td>4.12 (0.76)</td>
<td>−1.23</td>
<td>2.89</td>
</tr>
</tbody>
</table>

aScSE = Sunscreen-Use Self-Efficacy; NSc = Norms about Sunscreen Use; ScE = Sunscreen-Use Expectancies; ISc = Impediments to Sunscreen Use. Items are listed in Figure 1.

equation modeling procedures (including confirmatory factor analysis), the inter-relationships among items were examined. Estimates of the Independence Model $\chi^2$, a test of significant covariance between the observed variables of the model (Bentler, 1995), were statistically significant in both the sunscreen-use model ($\chi^2_{(159)} = 1562.3, P < 0.001$) and the sun-avoidance model ($\chi^2_{(85)} = 1202.4, P < 0.001$). Additionally, within the sunscreen-use model, every correlation between items with the same hypothesized factor was significant (i.e. $P < 0.05$); correlations between items of differing hypothesized factors also tended to be significant, but were generally smaller in magnitude than those representing items from the same hypothesized factor. Within the sun-avoidance model, every correlation between items with the same hypothesized factor, with the exception of one pair of items, was significant ($P < 0.05$), whereas items that did not share a hypothesized factor were less consistently related (over 20 correlations of this type were not significant) and generally smaller in magnitude. (Complete correlation and covariance matrices are available from the authors upon request.)

**Goodness of fit of confirmatory factor analytic models**

**Sunscreen-use model**

The initial sunscreen-use model (Model A1) did not fit the data adequately according to the specified criteria (Table III). CFI <0.90, RMSEA >0.08, and its residuals were large and positively skewed. A series of four more sunscreen-use models was developed and tested. Of the four later models, Model A5 was considered superior on the basis of the criteria used to compare alternative models. The RMSEA and AIC values for Model A5 were lower than the corresponding values for all other models tested, and the CAIC value was lower than all but the initial model. Also, Model A5 fit...
Sun-avoidance model cross-validation (Model A5 was refined through a series of post hoc modifications within the sunscreen-use model refinement subsample, Model A5 was cross-validated in an independent sample of 200 parents (Table III). In brief, CFI >0.90, RMSEA <0.08, and the standardized residuals, generally small (only one above 0.20 and only one less than −0.20) and normally distributed around zero.

Sun-avoidance model

Like the sunscreen-use model, the initial sun-avoidance model (Model B1) did not fit the data adequately according to goodness-of-fit criteria (Table III). The CFI did not meet its criterion, the RMSEA was the minimum for its criterion, and the residuals were large and positively skewed. A series of four more sun-avoidance models was developed and tested. Of the four later models, Model B5 was considered superior on the basis of the criteria used to compare alternative models. The RMSEA and AIC values for Model B5 were lower than the corresponding values for all other models tested, and the CAIC value was lower than all but two models (Model B1 and B3). Also, Model B5 fit the data well according to absolute criteria (CFI = 0.95; RMSEA = 0.053), and its standardized residuals were generally small (three
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of 171 greater than |0.20|) and less positively skewed than those of all other models tested.

Model B5 differed from the initial sun-avoidance model (Model B1) in four ways. First, two items examined in the initial model were omitted from Model B2. One of these items was a normative item that did not reflect a shared referent group with the other normative items (‘most parents think’) and had a low loading. The other item was the only item of the tanning expectancies factor that suggested a subjective weighing of the importance of tanning relative to sun protection (in contrast to the other items that expressed only tanning-specific beliefs) and had a significant LM test for cross-loading to other factors. Second, correlated error terms for items with identical normative referents were allowed in Model B3. Third, correlated error terms for all items addressing limiting time outside during peak sun hours were allowed in Model B4. Fourth, correlated error terms were allowed between two very similar tanning items addressing how parents perceive their appearance (‘attractive’, ‘look good’) when they have a suntan (Model B5).

As Model B5 was refined through a series of post hoc modifications within the sun-avoidance model refinement subsample, Model B5 was cross-validated in an independent sample of 200 parents (Table III). As with the sunscreen-use model, the sun-avoidance model adequately cross-validated to the independent sample. CFI > 0.90, RMSEA < 0.08, and the standardized residuals were generally small (none greater than |0.20|) and normally distributed around zero. (Complete sets of models are available from the authors upon request.)

**Parameter estimates of final models**

A schematic of the final and best-fitting sunscreen-use model (Model A5) is presented in Figure 3. All the factor loadings between the observed variables (scale items) and the sunscreen-use factors (hypothesized determinants) were statistically significant: factor loadings and factor correlations observed in the final sunscreen-use model (Model A5) are presented. Values in parentheses indicate observed values in the initial subsample (n = 146). Values outside of parentheses are the estimates in the cross-validation sample (n = 200).
significant. In addition, all loadings but two were greater than 0.30, further suggesting that the items were indicative of their hypothesized factors. Those items with loadings less than 0.30 included a normative item in the initial sample (path in parentheses for NSc3) and an expectancy item in the cross-validation sample (path outside parentheses for ScE1). In both cases, the loadings for those items were above 0.30 in one of the two samples, suggesting that the item would be a good indicator of its factor. Also, as observed in Figure 3, all factors were significantly correlated to each other in at least one of the samples, with the exception of the impediments factor, which was not related to sunscreen-use expectancies in either sample. Of those scales that were significantly correlated, the correlation was not so high as to raise concerns that the hypothesized factors were not tapping into distinct constructs.

A schematic of the final sun-avoidance model (Model B5) is shown in Figure 4. All factor loadings between sun-avoidance items and sun-avoidance factors were statistically significant. Additionally, all loadings were greater than 0.30, except for one loading in the cross-validation sample (path outside parentheses for NSA3). Also, all of the hypothesized determinants of sun avoidance were significantly inter-related in at least one of the samples employed.

**Assessing scale internal consistency**

Scale reliability estimates were provided by calculating coefficient α (Cronbach, 1951) in the combined sample. For the sunscreen-use model, the reliability estimates were 0.91, 0.81, 0.70 and 0.73 for the scales representing sunscreen-use self-efficacy, norms about sunscreen use, sunscreen-use expectancies and impediments to sunscreen

Fig. 4. Final confirmatory factor analytic model of sun avoidance. All statistically significant factor loadings and factor correlations observed in the final sun-avoidance model (Model B5) are presented. Values in parentheses indicate observed values in the initial subsample \((n = 151)\). Values outside of parentheses are the estimates in the cross-validation sample \((n = 200)\).
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Table IV. Descriptive statistics for sun-protection scales and intercorrelations with sun-protection behavior

<table>
<thead>
<tr>
<th>Scale</th>
<th>Range</th>
<th>M (SD)</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Behavioral measures</th>
<th>Sun use</th>
<th>Sun avoidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunscreen-use self-efficacy</td>
<td>5-25</td>
<td>17.57 (4.24)</td>
<td>-0.29</td>
<td>0.08</td>
<td>0.62&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.17&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Norms about sunscreen use</td>
<td>10-30</td>
<td>19.85 (4.51)</td>
<td>-0.87</td>
<td>2.20</td>
<td>0.29&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Sunscreen-use expectancies</td>
<td>13-30</td>
<td>23.91 (3.35)</td>
<td>-0.98</td>
<td>2.75</td>
<td>0.48&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.24&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Impediments to sunscreen use</td>
<td>3-15</td>
<td>9.33 (2.56)</td>
<td>0.40</td>
<td>-0.26</td>
<td>0.11&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>Sun-avoidance self-efficacy</td>
<td>6-25</td>
<td>16.85 (3.69)</td>
<td>0.34</td>
<td>-0.08</td>
<td>0.09</td>
<td>0.13&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Norms about sun avoidance</td>
<td>6-20</td>
<td>14.18 (2.64)</td>
<td>-0.66</td>
<td>1.06</td>
<td>-0.25&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Tanning expectancies</td>
<td>6-20</td>
<td>13.74 (3.49)</td>
<td>-0.37</td>
<td>-0.62</td>
<td>0.16&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.29&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Sun-avoidance expectancies</td>
<td>12-25</td>
<td>20.36 (2.60)</td>
<td>-0.63</td>
<td>0.74</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>4</sup>Higher scores reflect more desirable levels of the construct.
<sup>b</sup>P < 0.05.
<sup>c</sup>P < 0.01.
<sup>d</sup>P < 0.001.

use, respectively. For the sun-avoidance model, the reliability estimates were 0.87, 0.62, 0.82 and 0.63 for the scales representing sun-avoidance self-efficacy, norms about sun avoidance, tanning expectancies and sun-avoidance expectancies respectively. The sunscreen-use scale was highly internally consistent (α = 0.86), but the sun-avoidance behavioral scale was less so (α = 0.56). Additionally, confirmatory factor analytic models of these behavioral scales (single-factor, no correlated errors) were tested in a combined sample. These models supported the unidimensional structure of the sunscreen-use behavioral scale (e.g. CFI = 0.94; GFI = 0.93) and the sun-avoidance scale (e.g. CFI = 0.91; GFI = 0.98).

**Associations of scales with sun-protection behavior**

The relationships between the sunscreen-use and sun-avoidance psychosocial scales derived from confirmatory factor analysis and their associated sun-protection behaviors were examined to assess the convergent validity of the instrument. Pearson product correlations were employed because the variables did not appear to deviate from normality to a high or moderate degree. Three of the sunscreen-use model factors shown in Table IV (sunscreen-use self-efficacy, norms about sunscreen use and sunscreen-use expectancies) had significant pairwise correlations with sunscreen use that supported convergent validity (P < 0.001). When adjusted for attenuation due to measurement error in the variables, these associations became even stronger: sunscreen-use self-efficacy (r = 0.70), norms about sunscreen use (r = 0.35) and sunscreen-use expectancies (r = 0.62). However, contrary to the postulates of the model, sunscreen use and impediments to sunscreen use were not significantly correlated. Likewise, three of the sun-avoidance model factors shown in Table IV (sun-avoidance self-efficacy, sun-avoidance expectancies and norms about sun avoidance) had significant pairwise correlations with sun-avoidance behaviors that provided convergent validity (P < 0.05). When adjusted for attenuation, these associations became even stronger: sun-avoidance self-efficacy (r = 0.44), norms about sun avoidance (r = 0.22) and sun-avoidance expectancies (r = 0.49). The correlation between sun-avoidance behaviors and tanning expectancies was not significant.

Most potential determinants of behavior (Table IV) either did not relate to scales representing different behaviors (e.g. norms about sunscreen use was not related to sun-avoidance behavior) or correlated more strongly with the hypothesized behavior (e.g. sun-avoidance expectancies was more highly correlated with sun-avoidance behavior than with sunscreen use). This informa-
tion further supported the validity of the study variables with one exception—the significant, yet negative, correlation between tanning expectancies and sunscreen-use behavior.

Discussion

This study represents the first test of the adequacy of these newly developed scales (PSPS) to assess the various psychosocial factors related to parental practices of sunscreen use and sun avoidance to reduce sun exposure among preschool children. We are encouraged by the findings that suggest that self-efficacy, norms and expectancies are associated with performance of sun-protection behavior. The findings are consistent with SCT. Studies in the area of skin cancer prevention also have shown a relationship between sun-protection behavior and self-efficacy (Jackson and Aiken, 2000), perceived behavioral control (Hillhouse et al., 1997; Martin et al., 1999), norms (Hillhouse et al., 1997; Glanz et al., 1999; Jackson and Aiken, 2000) and attitudes (Vail-Smith et al., 1997).

Little emphasis has been placed on the construct validation of theory-based scales in the skin cancer prevention literature and there are few reports on factor analytic studies. Because the PSPS consisted of new items not tested previously, we examined the construct validity of these scales using confirmatory factor analysis. We expected that the models for analyzing underlying factors would have to be refined. So, we used additional cross-validation samples to reduce the possibility of sample-specific findings. There may be alternative models that similarly account for the inter-relations among the items. However, given the theoretical basis for our four-factor model, the restriction of modifications to only those with theoretical and empirical justification, and, most importantly, the consistently highly desirable scores on a broad range of goodness-of-fit indices in the initial as well as the cross-validation samples, we feel confident that the current sets of models are reasonably descriptive of the data.

There was evidence for the convergent validity of the sunscreen-use self-efficacy, norms about sunscreen use and sunscreen-use expectancies scales derived from the sunscreen-use model. However, impediments was not associated with sunscreen use. Impediments listed in this scale included messiness and difficulty in applying sunscreen, and the child’s dislike of sunscreen. Perhaps such impediments are encountered routinely by parents and are not significant in explaining behavior. Focus groups conducted during scale development and further experience with the target population have revealed that parents of preschool children do find cost and time to be impediments to routine sunscreen use. Further revision and expansion of the scale to more fully capture the construct of impediments may improve convergent validity.

There was evidence for the convergent validity of scales for sun-avoidance self-efficacy, norms about sun avoidance and sun-avoidance expectancies, although the associations between these psychosocial factors and the sun-avoidance scale were less pronounced than similar relationships reported for the sunscreen-use model. The tanning expectancies scale, which included three items on personal tanning habits, was inter-related with the other sun-avoidance scales; however, there was not evidence for the convergent validity of this scale. This scale was more strongly oriented toward personal tanning beliefs (three of four items) than beliefs about the child’s tanning. While it may be argued that a more relevant scale would focus on the child as the referent, previous studies have suggested that negative parental attitudes toward tanning, without specific reference to child’s tanning, may be related to the parental practice of sun protection for children (Miller et al., 1999).

A recent review of the literature on children and skin cancer prevention efforts comments that many of these studies do not report scale reliability estimates or measures are based on single items (Buller and Borland, 1999). In general, internal consistency reliability estimates support the use of our behavioral and psychosocial scales in evaluating the Sun Protection is Fun! program. Because we were interested in multiple aspects of sunscreen-use behavior (i.e. when the sunscreen was applied...
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and reapplied, the SPF of the sunscreen, and whether sunscreen was taken on outdoor trips), we developed a scale focused on sunscreen use, instead of relying on one item to measure sunscreen use. The sunscreen-use scale was internally consistent (α = 0.86). In other studies, single scales combining different sun-protection behaviors (e.g. clothing, sunscreen and shade) to assess parental or caregiver practices have been reliable (Buller et al., 1995; Rodrigue et al., 1996; Glanz et al., 1999; Parrott et al., 1999).

Although a confirmatory factor analysis supported our sun-avoidance scale’s unidimensionality, the internal consistency of the scale was less than desired, although consistent with other such scales reported in the literature (Broadstock et al., 1996). Likewise, the α coefficients of the norms about sun avoidance and sun-avoidance expectancies scales were less than 0.70, although they still reflected a modest level of internal consistency reliability, and the scales were significantly related to behavior as suggested by theory. Further development and expansion of the scales may serve to improve the consistency of the items in measuring norms and expectancies related to sun avoidance. Conceptualizing distinct models for each of the sun-avoidance behaviors, similar to our approach for sunscreen use, may be beneficial and items related to protective clothing may need to be reworded to specify the articles of clothing of importance (e.g. wide-brimmed hats).

Few studies of caregivers have incorporated scale measures of self-efficacy related to sun protection (Rodrique et al., 1996; Parrott et al., 1999) or perceived behavioral control, an analogous construct from Theory of Planned Behavior (Hillhouse et al., 1997; Martin et al., 1999). Because self-efficacy measures are more informative when related to specific behaviors (Bandura 1986), we developed separate self-efficacy scales for sunscreen use and sun avoidance, and our reliability estimates are consistent with reported estimates for single scales measuring self-efficacy for sun protection (Rodrique et al., 1996; Jackson and Aiken, 2000). Self-efficacy was moderately correlated with behavior in this study, providing convergent validity for these scales.

Because the present sample was predominantly female (91%) and Caucasian (62%), it was impossible to determine whether the resulting factor analytic models would also fit samples dominated by males or by another ethnic or racial group. Also, the sampling design employed in the current study did not allow comparison of respondents with non-respondents. Future sampling designs, preferably random, should afford this opportunity. To more fully understand scale reliability, the temporal stability of the scales should also be assessed.

The scales would benefit from continued development accompanied by additional validity and reliability testing in different populations. Some general directions are suggested. First, by measuring self-evaluative reactions (an important component of SCT) and expanding on the physical and social outcome expectations, validity and reliability may be improved. Second, further item development can be grounded in the firsthand experience gained during the course of the current study to evaluate the Sun Protection is Fun! intervention, thus improving the content validity of the scales. Third, while the self-efficacy scales in the current study are considered valid and reliable, it may be desirable to further refine them to include items that assess perceived confidence in practicing sun protection in certain situations or locations (i.e. when others are not doing so, when there is insufficient time, or at the beach). It is important to note that all decisions on expanding and refining the scales also depend on the investigator’s assessment of respondent burden.

Early childhood is a critical time for the practice of sun protection. Although psychosocial factors related to sun protection and sun avoidance have been suggested in the literature, and reliable measures have been documented, there are few reports on scale validation. Further, there is a lack of information on the reliability and validity of behavioral and related psychosocial measures designed for the parents of young children. Thus, we believe that our report on the reliability and
validity of the PSPS, focusing on the parents of preschool children, contributes to the measurement literature on skin cancer prevention. The results of this study provide a basis for the reliable and valid measurement of psychosocial factors related to parental sun-protection practices to reduce sun exposure in young children. These scales may be used to more fully understand the determinants of sun-protection practices and evaluate intervention programs designed to influence such behaviors.

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References


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