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Effects of Program Exposure and Engagement with Tailored Prevention Communication on Sun Protection by Young Adolescents

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Abstract

Few family-based interventions to increase sun safe behavior among adolescents have been evaluated. The present study tested an intervention that included tailored and nontailored print communications delivered by mail to adolescents (age 11 to 15) and their parents who were also participating in an evaluation of an in-school intervention. The use of sunscreen, protective clothing, and avoidance of the sun were promoted, and family communication and environmental change strategies were fostered. Adolescents and their parents were pretested in May of 2002 and posttested from August to October. Adolescents (N=599) were stratified on experimental condition in the in-school study (in-school intervention vs control) and randomly were assigned from within strata to receive (N=288) or not receive (N=311) the summer intervention materials. No statistically significant effects were found for adolescents between the randomized experimental conditions. Parents' had increased knowledge ($F = 5.52, p < .05$) and propensity to have their child wear sunglasses ($F = 4.07, p < .05$). Greater program exposure/engagement led to enhanced sun protection behavior (e.g., fewer sunburns) and psychosocial factors among adolescents and parents. Greater exposure/engagement led to improvements in family interaction and home environment (e.g., shade audit completed). Future research is needed on exposure/engagement with family-based health messaging and on family-based sun safety programs for adolescents.

Introduction

One priority for stemming the epidemic of skin cancer in the United States is to improve sun protection of children (American Cancer Society [ACS], 2005; Centers for Disease Control and Prevention [CDC], 2003). It is estimated that one-quarter of a person's lifetime sun

exposure occurs during childhood (Godar, Urbach, Gasparro, & van der Leun, 2003) and severe blistering sunburns during this period may elevate risk of developing melanoma (Weinstock et al., 1989). Unfortunately, many children are not regularly protected (Lowe, Balanda, Gillespie, Del Mar, & Gentle, 1993; Robinson, Rigel, & Amonette, 1997; Saraiya, Hall, & Uhler, 2002). School-based instruction, programs in outdoor recreation, and communication with parents have been successful at promoting sun protection, mainly among preadolescent children (Buller & Borland, 1998; CDC, 2003; Turrisi, Hillhouse, Robinson, Stapleton, & Adams, 2006; Walkosz et al., 2007). Few studies, if any, have tested health communication intended to improve sun protection behaviors among adolescents.

Adolescents are a particularly important target group. Personal responsibility for health behaviors increases and tanning norms emerge during adolescence (Lowe et al., 1993; Robinson et al., 1997; Saraiya et al., 2002). Recently, our research group showed that school-based education in grades 6-8 improved self-reported sun protection by adolescents (Buller et al., 2006; Reynolds, Buller, Yaroch, Maloy, & Cutter, 2006). This study evaluated the effectiveness of a theory-based intervention with six sessions delivered in the classroom by existing instructors and targeted perceived risk for skin cancer, positive outcome and self-efficacy expectations for sun protection behaviors, key prevention skills (e.g., applying sunscreen), goal setting, self-monitoring, barrier resolution strategies, knowledge, and selected other attitudes (e.g., perceived norms for tanning). The program was delivered and evaluated in the spring semester and demonstrated changes favoring intervention on a sun protection index, wearing protective clothing, and use of sunscreen. Significant intervention differences also were found for increased knowledge, decreased perceived barriers for sunscreen use, increased self-efficacy expectations about sun safety, and reduced positive attitudes toward sun tanning. No other sun protection communication strategies have been tested with adolescents in a family-based setting. Recent work has tested a family-based sun protection intervention targeting preadolescents and with intervention materials delivered to parents (Turrisi et al., 2006).

A promising method of health communication is to deliver messages tailored to the characteristics, perceptions, and circumstances of at-risk populations (Dijkstra, de Vries, Roijackers, & van Breukelen, 1998; Kreuter, Farrell, Olevitch, & Brennan, 2000; Kreuter & Wray, 2003). Tailored messages have improved diet, tobacco prevention, physical activity, mammography use, and headache prevention with adults when compared with both untailored communication and no communication (Brinberg, Axelson, & Price, 2000; Dijkstra, 2005; Jacobs et al., 2004; Lauver, Settersten, Kane, & Henriques, 2003; Nicholson, Hursey, & Nash, 2005; Williams-Piehot, Pizzaro, Schneider, Mowad, & Salovey, 2005; Williams-Piehot, Schneider, Pizarro, Mowad, & Salovey, 2003). Tailored messages have been used only recently with children (Ausems, Mesters, van Breukelen, & De Vries, 2004; Perez-Rodrigo et al., 2004), with one study reporting favorable effects on smoking prevention (Ausems et al., 2004). The increased cognitive effort, perceived relevance, personalization, and feedback produced by tailored health communication (Dijkstra, 2005; Kreuter & Wray, 2003) might have positive effects on maturing children.

In sum, no skin cancer prevention programs have been developed and evaluated targeting adolescents and their parents and using tailored intervention strategies. In the present study,

such a program was developed, delivered during the summer, and evaluated among to adolescents aged 11-13. These adolescents were drawn from the sample of a randomized trial testing school-based sun safety instruction (Buller et al., 2006; Reynolds et al., 2006). Content in the summer program was based on principles of social cognitive theory (Bandura, 1986, 2001), as was the school-based instruction. Key messages were tailored to children's motivation to tan, perceived personal risk for skin cancer, self-efficacy expectations for sun protection, current sun protection behavior, and gender. The main hypothesis was that children who were sent the tailored communications would report greater sun protection at the end of the summer than those not sent the tailored communications. Prior exposure to the school-based instruction was tested as a moderator of this effect, although a previous study on smoking prevention failed to find an interaction between out-of-school tailored messages and in-school instruction (Ausems, Mesters, van Breukelen, & De Vries, 2002). Finally, the prediction that exposure to tailored communication and engagement with the learning activities contained in the communication would be positively associated with improvements in sun protection was examined.

Methods

Sample and Population

Parents and adolescents who were previously consented for participation in an evaluation of a school-based sun safety program conducted during the school year were approached to solicit participation in a summer intervention. Parental consent and student assent was secured for 697 students (34% of the sample for the in-school trial). All consent and assent forms were approved by the Institutional Review Boards at the participating institutions. Of these 697 adolescents, 599 completed the survey prior to summer and were considered eligible.

Study Design and Procedures

The evaluation of the summer intervention was conducted within the context of the evaluation of the Sunny Days Healthy Ways (SDHW) middle school curriculum (Buller et al., 2006; Reynolds et al., 2006; Yaroch, Reynolds, Buller, Maloy, & Geno, 2006). The SDHW middle school curriculum was evaluated during the 2001-2002 school year using a stratified pair-matched group-randomized pretest-posttest controlled design enrolling schools in Colorado, New Mexico, and Arizona. Schools were stratified by state and paired on size, grade levels participating, proportion of minority students, and proportion of students on free or reduced meals. Adolescents were pretested in February and March of 2002, received the SDHW middle school curriculum from mid-March to the end of April 2002, and were posttested in May 2002. Compared with children in control schools, children receiving the SDHW middle school curriculum reported more frequent sun protection ($p < .004$) and a greater proportion wore long-sleeved shirts during recess ($p < .0001$) and applied sunscreen ($p < .0001$). Exposure to the curriculum improved knowledge ($p < .0001$), decreased perceived barriers to using sunscreen ($p < .005$), enhanced self-efficacy expectations ($p < .06$) about sun safety, and reduced favorable attitudes toward sun tanning ($p < .003$ to $< .0001$).

Adolescents and their parents from schools in Colorado and New Mexico then were recruited to participate in the evaluation of a summer intervention program. To evaluate the summer intervention, adolescents were stratified according to the condition assignment in the SDHW middle school curriculum evaluation (curriculum v. no curriculum). Within each strata, adolescents randomly were assigned to either receive or not receive the summer intervention program (unit of randomization for evaluation of the summer intervention was the individual student). This created four experimental conditions in a 2 (SDHW middle school curriculum Yes/No) $\times$ 2 (summer intervention Yes/No) factorial design: (a) receiving no SDHW middle school curriculum but receiving the summer intervention ($N=115$), (b) receiving no SDHW middle school curriculum and no summer intervention ($N=128$), (c) receiving the SDHW middle school curriculum and the summer intervention ($N=173$), and (d) receiving the SDHW middle school curriculum but no summer intervention ($N=183$). Pretest assessment for evaluation of the summer intervention was completed in the schools for students and by telephone survey for parents in May of 2002. Posttest assessment was completed in September and October of 2002 for students and in August and September of 2002 for parents using the same methods as those employed in the pretest.

Description of the Summer Intervention

The summer intervention program was delivered to adolescents and parents using cover letters, *Sun Scoop* newsletters for parents, Summer Raze newsletters for adolescents, and small gifts to enable adolescents to practice the recommended sun protection. All materials were mailed to participants in their homes. The four parent newsletters and four adolescent newsletters were mailed at equal intervals throughout the summer.

Parent Intervention Materials

Parent intervention materials included three main components: an introductory cover letter, a series of newsletters, and a booklet. The introductory cover letter was sent to parents with the first *Sun Scoop* newsletter. It described the summer program and provided information about risk for skin cancer and sun safe behaviors that was designed to be motivating to parents. A small portion of this letter was tailored based on the sun sensitivity of their adolescent (based on responses the student provided on the pretest survey in the main trial; see below) and provided information stating the importance of engaging in sun safe behavior.

The four-page parent newsletters were personalized using their name and address and had generic information on sun safety provided in four topics, including *Talking to Your Child*; *Ready, Set, Go*; *Did You Know*; and *What's in Your Child's Newsletter This Month*. Together these sections gave parents tips, facts, and strategies needed to promote sun safe behaviors in the family. *Talking to Your Child* provided skills for parent-child communication in newsletters 1 and 2, dealing with resistance to change in newsletter 3, and ways to work together as a family to create a sun safe home in newsletter 4. *Ready, Set, Go* focused on sun protection tips and skills with *Ready* providing background about a topic, *Set* describing specific ways that sun safe behavior could be enacted (e.g., avoiding a sunburn), and *Go* providing a summary of the material covered. The *Did You Know* section provided a

brief, highly visual description of an important skill for producing sun safe behavior (e.g., reading a UV index, types of sun protective headgear).

Finally a *Sun Scoop* booklet was developed and distributed to each family. This booklet contained selected behavioral skill based knowledge and forms to be used in behavior changes exercises completed with the adolescents.

Student Intervention Materials

The student materials included an introductory cover letter and tailored newsletters. The first adolescent newsletter was accompanied with the cover letter, addressed directly to the adolescent, and briefly describing the summer program. Also included was the first of four gifts that might facilitate skill development and behavior change (e.g., UV-sensitive card).

The four-page adolescent newsletters contained both generic and tailored messaging. The newsletters were divided into six topics including the *Summer Raze* story, *Just 4 U*, *Amaze Me*, *Q & Aze*, *Family Activity*, and *Visual Skill Building*. The *Summer Raze* story followed two main characters over the course of the four newsletters, Kirk and Kara, who were middle school students and described how their relationship develops. Within these stories were messages advocating sun safety seamlessly integrated into the storylines. *Just 4 U* provided a fun fact related to sun safety. *Amaze Me* presented a myth about skin cancer or sun safety (e.g., having a suntan protects my skin from sunburns) and then provided information refuting and explaining this misstatement. *Q & Aze* posed questions about sun protection of interest to adolescents (e.g., are tanning beds more dangerous than the sun?) and answered these questions. The *Family Activity* provided an opportunity to complete a series of learning activities with parents and siblings that would change the home environment toward increasing sun safe behavior and reducing family risk for skin cancer. For example, in newsletter 1, families worked together to complete an audit of the home environment (e.g., we have sunscreen in our house with an SPF 15+) and the families behavior related to skin cancer (e.g., we all put sunscreen on before we leave the house to go outdoors). The *Visual Skill Building* section used pictures and graphics with minimal text to emphasize key skills for sun safety (e.g., the shadow rule—remember, when your shadow is shorter than you are, it's definitely time to get out of the sun).

The adolescent's name and address was personalized as described for the parent newsletter above. The tailoring variables included Motivation to Tan (high, low), Perceived Personal Risk for Skin Cancer (high, medium, low), Self-Efficacy for Sun Protection (high, low), Current Sun Protection (high, low with feedback on highest perceived barrier to sunscreen use and use of shade), and Gender (male, female). A message library was developed and a scoring algorithm created to insert the appropriate tailored message into a predetermined field within a Quark graphics design file for each newsletter. Tailoring in all four newsletters was based upon individuals' responses to the pretest and posttest surveys in the main trial completed before the summer began and embedded in the topic of each newsletter.

Measures

Adolescent Questionnaires—The surveys contained self-report measures on sun protection. The primary measures were adapted from a sun protection diary (Girgis, Sanson-Fisher, Tripodi, & Golding, 1993)—time outside, mostly in sun/shade, wearing a head covering, wearing clothing that covered shoulders/arms, wearing clothing that covered legs, and wearing sunscreen. Adolescents completed these reports for times that they were outdoors yesterday. A weighted body coverage measure was created for each time outdoors, ranging from 0 to 15 (Girgis et al., 1993). This diary measure was validated in a pilot study (Yaroch et al., 2006). Also, a series of 5-point frequency items assessed how often children applied sunscreen with SPF of 15 or more, wore clothes covering most of the body, wore a hat, limited time in the sun during midday, stayed in the shade, and wore sunglasses. A mean rating was calculated across items. Mean ratings were modestly correlated with colorimeter assessments in the main trial, indicating that those reporting more frequent sun protection showing less sun tanning of the skin (i.e., lower sun exposure; Buller et al., 2006).

Secondary measures of sun protection included adolescents' frequency of lying out in the sun to get a tan and using self-tanning cream, being sunburned during the past month and in the last summer, the SPF of sunscreen used, and perceived importance of having a tan (1=not important; 4=very important). Sun safety knowledge was tapped with 10 true/false items, attitudes toward sun exposure and sun protection with 17 5-point Likert agree/disagree items, and self-efficacy expectations with 3-point (1=not sure; 3=sure) items linked to content in the curriculum. A summed knowledge score was created (Kuder-Richardson 20 reliability=0.71). Three factors were identified in the attitudinal items using principal components factor analysis: barriers to use of sunscreen (sunscreen is not in an easy place to get to; it's hard to choose the right sunscreen; sunscreens irritate my skin; sunscreens are messy to use; alpha reliability=0.47), barriers to sun protection (if I stay out of the sun, I will miss out on outdoor activities; I have to stop what I'm doing to put sunscreen on; a hat messes up my hair; I don't like the way I look in a hat; it's too hot to wear long sleeves and long pants in the summer; alpha reliability=0.41), and negative normative perceptions of sun safety (if I stay outside, my friends will think I'm weird; my friends will think I'm weird if I wear a hat; if I wear long sleeves and long pants, my friends will think I'm weird; my friends will make fun of me if I wear a hat; alpha reliability=0.54).

A reliability pilot study was conducted prior to completion of the main evaluation reported in the present manuscript. This involved completion of measures at two points in time 2 weeks apart. Overall kappa values estimating 2-week test-retest reliability were 0.39 for the 10 item knowledge scale, 0.67 for the 17 attitude items combined, and 0.54 for the four item self-efficacy assessment (all $p < 0.0001$; Yaroch, Reynolds, Buller, Geno, & Maloy, 2001). Internal consistency estimated at time 1 ($\alpha = 0.38$) and at time 2 ($\alpha = 0.47$) for knowledge were low. Concordance rates also were calculated and were more encouraging (82%–93%). Internal consistency for attitudes at time 1 ($\alpha = 0.58$) and time 2 ($\alpha = 0.65$) and self-efficacy (time 1 $\alpha = 0.75$, time 2 $\alpha = 0.76$) scales were higher in the reliability pilot study. In sum, reliability appears to be poor to fair for the attitude scales and good for self-efficacy. Evidence is mixed for knowledge with KR-20 estimates from the main evaluation study yielding fair/good reliability and estimates from the reliability pilot study being poor/fair. It

should be noted that internal consistency is not always indicative of quality scales (Bollen & Lennox, 1991) particularly for content such as knowledge and barriers. Further, our reliabilities were similar to those reported by Hewitt when studying sun safety among 10–11 year olds (Hewitt, Denman, Hayes, Pearson, & Wallbanks, 2001). In sum, knowledge demonstrated relatively low reliability coefficients. Scales with lower reliability will have greater error variance, biasing findings toward the null hypothesis. This made it more difficult to demonstrate significant effects for the summer program on knowledge. Confidence in these scales is also bolstered by their use in the earlier SDHW middle school study where changes resulting from the intervention program were detected (Buller et al., 2006; Reynolds, Buller, Yaroch, Maloy, & Cutter, 2006).

Skin cancer risk was measured by hair and skin color, skin sun sensitivity (propensity to sunburn and tan), and state lived for most of life (Weinstock, 1992). Demographics assessed included age, gender, Hispanicity, race, and number of siblings and number of parents in household. Number of days absent and typical grades also were asked.

Parent Questionnaires—The sun protection diary items described above also were completed by the parents, yielding estimates of time outside, mostly in sun/shade, wearing a head covering, wearing clothing that covered shoulders/arms, wearing clothing that covered legs, and wearing sunscreen. Parents completed these reports for times that they were outdoors on the previous Sunday. A weighted body coverage measure was created for each time outdoors, ranging from 0 to 15 (Girgis et al., 1993). A series of six 5-point frequency items assessed how often parents applied sunscreen with SPF of 15 or more, wore clothes covering most of the body, wore a hat, limited time in the sun during midday, stayed in the shade, and wore sunglasses. A mean rating was calculated across the items ($\alpha = 0.54$). Parents also reported on the steps taken to protect their children from UV exposure including use of sunscreen with SPF 15, use of sunscreen before school, use of hat and protective clothing, limitation of sun exposure, seeking of shade, and use of sunglasses ($N = 7$ items; $\alpha = 0.67$). Body coverage by sunscreen also was assessed ($N = 4$ items) from parents reporting on their own sunscreen use and that of their children (i.e., sun screen on face, neck, arms, other areas).

Sun safety knowledge was tapped with 10 true/false items, attitudes toward sun exposure and sun protection with 22 5-point Likert agree/disagree items, and self-efficacy expectations for actions taken to protect their children with seven 5-point items (1=strongly disagree; 5= strongly agree; $\alpha = 0.77$). A summed knowledge score was created (Kuder-Richardson 20 reliability=0.32). The attitude items were used to create scales on perceived risk for skin cancer ($N=3$ items; $\alpha = 0.59$), perceived outcome expectancies ($\alpha = 0.76$), and perceived barriers ($\alpha = 0.71$). Parents were asked using two Yes/No items if they had ever explained the need for sun protection to their children or talked to their children in the past 3 months about protecting their skin from the sun. If yes to the latter question, parents were asked who initiated the discussion and what was discussed. A series of six Yes/No items asked parents about changes made in the home or family environment to increase sun protection. Parents also were asked if they had set family goals for sun safety using a single Yes/No item, and if yes, were asked which of five goals were set ($N = 5$ items; Yes/No format).

Measures of Program Exposure and Engagement: The posttest surveys completed by adolescents and parents contained items measuring exposure to the summer program materials and engagement with the learning activities and suggestions for discussions about sun protection. Measures were adapted from earlier studies on sun safety and media use completed by the authors (Buller, Borland, & Burgoon, 1998; Buller, Burgoon, Hall, Levine, Taylor, Beach, et al., 2000a, 2000b; Burgoon, Burgoon, & Buller, 1987). All items used Yes/No format except where indicated below. Adolescents were asked if they had received any newsletters called *Summer Raze*, which provided information about sun safety. If they answered yes, they were asked how many of the newsletters they read (0 to 4) and whether they remembered reading each of seven sections from the newsletters. Adolescents also were asked if they talked with a parent or guardian about any information from the *Summer Raze* newsletters, if they did any of the activities contained in the *Summer Raze* newsletters with a parent or guardian, and if they liked the *Summer Raze* newsletters, using a 4-point response format that ranged from “I didn’t like them at all” (a 1 on the response format) to “I like them a lot” (a 4 on the response format).

Exposure to the parent newsletters was assessed with 18 items. Parents were asked to report whether they had received and read the newsletters and how many of the four newsletters were read (range = 0–4). Parents were asked a similar question about readership of the child newsletters. A series of topics included in each newsletter were noted, and parents were asked to indicate which of these topics were read about in the newsletters. Eleven items were asked about receipt and use of the *Sun Scoop* parent booklet: whether they had received it, read it, and how much was read (a little, some, most, all). A series of topics included in the *Sun Scoop* booklet were noted, and parents were asked to indicate if they had read about that topic in the booklet. Parents’ engagement with the learning activities were assessed by asking them whether they used any of the information in the newsletters to teach their children about sun safety and the extent to which the child newsletters were acted upon by the family. This included a specific delineation of four family activities included in the newsletters (i.e., talking with child about child newsletters, helping child with activities in child newsletters, using information in child newsletters to teach child about sun protection, using information in parent newsletters to teach children about sun protection).

Analysis Plan—Descriptive statistics were calculated and compared to confirm that the randomization procedures yielded a balanced allocation to the summer intervention and control groups. In order to test the effects of the summer intervention on the adolescents, analyses were performed on each of the behavioral and psychosocial outcomes at the end of the summer, using the presummer value of each outcome as a covariate along with gender, age, and skin sensitivity to burning as additional covariates. A linear fixed-effects model was employed for the continuous and Likert scale outcome measures; a logistic model was used for the binary outcomes. A subsequent analysis tested for the moderating effect of exposure to the in-school instruction by including it as an additional covariate. As described earlier in this article, individual students were randomized to receive or not to receive the summer intervention materials from within strata reflecting their original treatment assignment in the SDHW middle school program (received curriculum, did not receive curriculum). Because individuals were assigned to condition, we chose to ignore the

clustering that was used in the randomization to the in-school instruction. We reran the results with a stratifying variable for cluster with similar results. Thus, for simplicity, this variable was not used in the evaluation of the summer intervention program, and hierarchical analysis procedures were not utilized.

Finally, the predicted positive association between program exposure and engagement with the learning activities was analyzed by creating two composite variables within the group randomized to receive the summer program. A binary exposure variable was created for both adolescents and parents (i.e., read any newsletters [1] vs. not read [0]). A measure of adolescents' level of engagement was created within the intervention group by awarding one point for each behavior—reading newsletters, talking with parents about newsletters, and performing the learning activities in the newsletters (range = 0–3). Parents' engagement level was calculated in a similar fashion, summing affirmative responses to reading any of the adolescent newsletters, talking with adolescents about adolescent newsletters, helping adolescents with activities in the adolescent newsletters, using information in adolescent newsletters to teach adolescents about sun protection, reading any of the parent newsletters, using information in parent newsletters to teach adolescents about sun protection, and reading the *Sun Scoop* booklet (range = 0–7). In separate univariate analyses, posttest values of the outcome variables were modeled against each dose variable and presummer outcome value.

Results

Sample

Of the 2,038 students enrolled in the evaluation of the in-school instruction, 599 students met the criteria for randomization in the evaluation of the summer program: (a) consent from parent for school-based and summer programs; (b) assent from child for school-based and summer programs; and (c) completion of the survey before the summer. Two hundred eighty eight were randomized to receive the summer newsletters, and, of these, 161 (56%) completed the survey at the end of the summer. Three hundred eleven students did not receive the newsletters, and, of these, 180 (58%) were surveyed again at the end of the summer. The transition of students from middle school to high school in the eighth grade portion of the sample decreased overall posttest completion rates. The posttest completion rate excluding eighth graders was 72% and with eighth graders included was 57%. See Table 1 for the distribution of demographic variables. The make-up of the students within the two summer program conditions did not differ on any of the demographic variables tested. Those completing posttest were compared with those who did not complete posttest, using pretest demographic data. Differences were found for only two variables, race ($\chi^2(4) = 10.7, p < .03$) and age ($\chi^2(4) = 33.6, p < .0001$). A higher proportion of Whites and children 14 years and older did not complete the posttest.

Of 494 parents who completed a survey before, after the summer, or both times, 478 (97%) had a matching student record (352 [74%] completed both surveys; 112 [23%] completed only the first survey; 14 [3%] completed only the second survey). This yielded 212 families (93 summer program, 119 no summer program) in which both the parent and the student each completed the surveys before and after the summer. Parents primarily were married

(76% married, 20% divorced, 3% never married, 1% widowed or living together), 87% Non-Hispanic, predominantly White (88% White, 6% African American, 3% Asian, 2% American Indian, 1% Other), 85% female, and had a mean household size of 4.3 and mean age of 43.2 years. Among parents, 32% were college graduates, 24% completed graduate school, 22% completed some college, 19% were high school graduates, and 3% completed some high school. For parents, marital status varied between the summer curriculum conditions ($p < .05$); the summer program group contained a smaller percentage of married parents than the no summer program group.

Attrition analyses compared adolescent participants in the summer program with those who did not participate on gender, race, ethnicity, and age. The two groups differed at the $p < .05$ level on race with participants having a higher percentage of White adolescents (77% vs. 87%) and on age ($p < .05$) with participants being older (Age 11: 5% [nonparticipant] vs. 3% [participant]; Age 12: 33% vs. 20%; Age 13: 47% vs. 44%; Age 14: 15% vs. 33%). Attrition analyses also were completed on parent participants versus nonparticipants. Significant differences were observed at the $p < .05$ level on education (nonparticipant [NP] = 38%; participant (P) = 62% college graduate or graduate school), marital status (NP = 66%; P = 79% married), ethnicity (NP = 20%; P = 11% Hispanic), race (NP = 76%; P = 92% White), gender (NP = 27%; P = 11% male), and age (NP = 41.5; P = 43.7 years).

Main Effect of Summer Program

For students, treatment group (i.e., summer program v. no summer program) had no effect on any of the sun protection outcomes tested. By contrast, the summer program did have a positive effect on parents' knowledge ($F = 5.52$, $p < .05$) and the propensity to have their child wear sunglasses ($F = 4.07$, $p < .05$). Thus, the hypothesized beneficial effects of the summer program were not confirmed with students and only modestly evident with parents. The interaction effect between receipt of the school program and the receipt of the summer program was tested for each student outcome variable examined and for the two parent outcomes with significant main effects. None of these terms were significant, indicating that there was no evidence that exposure to the SDHW curriculum in school moderated the effect of the summer program on child sun protection or on the parent sun protection outcomes.

Association of Exposure to Summer Program With Child Sun Protection

It was evident from their self-reports at the end of the summer that exposure to the summer program (i.e., number of items read) varied greatly across children and parents. (Number of newsletters read: Children: mean = 1.9, s.d. = 1.7, $n = 188$; Parents: mean = 1.8, s.d. = 1.6, $n = 125$). Positive relationships between exposure to the summer program and sun protection outcomes was evident both among students and parents supporting the hypothesis. Students who reported exposure to at least one newsletter had a greater favorable change in their self-reported use of shade when outside and number of sunburns received in the past month than students who were not exposed (Table 2). Those who were exposed to the program also had better sun safety knowledge and were less likely to believe that sunscreens irritated their skin or that they did not like the way they look in a hat than those who were not exposed. Finally, students who were exposed reported greater self-efficacy than nonexposed students—both on self-efficacy for using sunscreen with an SPF of 15 or greater and the composite

self-efficacy score. A significant result in the opposite direction, was however found for the SPF of the sunscreen used most often; participants exposed to the summer program reported using sunscreens with a lower SPF rating than those not exposed to it.

Similarly, parents who were exposed to the summer program more frequently limited their exposure to midday sun during the past month, had a better overall sun protection score during outdoor activities last month, and were more likely to apply sunscreen to their arms than those with no program exposure (Table 2). They also were less likely to see themselves as someone who lies in the sun to get a tan and had a greater self-efficacy toward sun protection than nonexposed parents. Finally, exposed compared with nonexposed parents were more likely to have reported explaining sun protection to their children in the past 3 months.

Association of Engagement With Summer Program With Child Sun Protection

Finally, we examined the relationship between engagement with the summer program and sun protection outcomes. Engagement with the program by children and parents was associated with more positive sun protection outcomes, again supporting a priori predictions. Compared with less engaged students, more engaged students more frequently wore sunglasses when outside for more than 15 minutes in the past month, were less likely to say that sunscreens irritated the skin, and had more positive self-efficacy for sun protection (i.e., using sunscreen with SPF greater than or equal to 15, wearing long sleeves or long pants, and composite self-efficacy score; see Table 3). Parents with higher program engagement reported more positive sun protection outcomes than those less engaged with it—i.e., more frequent sun protection of child (having child wear sunscreen with SPF 15 or higher on child and sunglasses and overall composite sun protection score for child), more frequent use of sunglasses by themselves, stronger belief that it is easy to protect kids from the sun, greater sun protection self-efficacy (composite score), plans to protect self and child more from the sun in next month, explaining sun protection to children in the past 3 months, and performing a shade audit of their home in the last month (Table 3).

To determine whether the above associations might be due to variables that produced both higher exposure and sun protection, the relationship of student and parent demographic characteristics with the exposure variable was examined. For students, only gender was significantly correlated with exposure, with females having higher values than males ($\rho = -0.18$, $p = 0.0268$). When the analyses were repeated for exposure including gender as a covariate, the relationship between exposure and reported number of burns in the past month went from significant to non significant ($p = 0.0455$ to $p = 0.0637$). The relationship between exposure and perceived chance of getting skin cancer changed from non significant to significant when gender was included ($p = 0.0502$ to $p = 0.0251$). No other relationships changed. No characteristics were significantly related to parent exposure or engagement.

Discussion

Simply sending tailored sun protection messages to children and parents during the summer did not improve sun protection of children in the families in this trial. There were modest positive effects on parents' knowledge and self-reported propensity to have their children

wear sunglasses. Although limited in number, these changes might prove important. Knowledge can be a necessary precursor to behavior change. The SDHW summer program may prepare parents to make personal changes in sun protection and to support changes for their children. Parents' increased propensity to have their children wear sunglasses conforms to guidelines for the greater use of UV protective sunglasses by children and may reduce long-term retinal damage (Glanz, Saraiya, & Wechsler, 2002; Services, 2004).

The lack of treatment effects in the primary comparisons may be due to an insufficient amount of the intervention material being read and utilized by the families. The sun protection messages delivered by mail had to compete for attention with other communications in the same medium (e.g., other direct mail or other health newsletters) and in other media (e.g., newspapers or television news stories). Adolescents and parents were free to decide which messages to attend to and which to ignore. In such circumstances, health communication usually achieves widely varying amounts of exposure across audience members. Even when same number of newsletters were sent on the same schedule to all participants, the messages received, read, and processed (sometimes called exposure and recipient responsiveness [Dane & Schneider, 1998; Dusenbury, Brannigan, Falco, & Hansen, 2003] varied between participants.

In any health communication program, exposure to messages is a necessary precondition to produce changes in health behavior (Dane & Schneider, 1998; Dusenbury et al., 2003; Hornik & Yanovitzky, 2003; Slater, 2004). Consistent with these prior findings, adolescents and parents in the present study who attended to the newsletters and parent booklet showed positive changes in sun protection including greater reported use of shade and fewer sunburns. Reducing sunburns is an important outcome for reducing the incidence of melanoma (Weinstock et al., 1989). Spending more time in the shade may help reduce sunburns and also cumulative UV exposure. Participants also demonstrated changes in the predicted direction on cognitions that theoretically support behavior change (i.e., knowledge, composite self-efficacy, self-efficacy to use sunscreen with an SPF of 15 or greater, and reduced barriers to sun protection). Contrary to prediction, participants who read the newsletters used sunscreens with a lower SPF rating. One possible explanation for this finding is that adolescents and parents may have used sunscreen with higher SPF levels prior to intervention before they realized that adequate protection could be achieved with an SPF of 15 if used properly.

Prevention programs depend on engaging at-risk individuals in learning mechanisms to achieve their intended aims (i.e., recipient responsiveness [Dane & Schneider, 1998; Dusenbury et al., 2003]). The summer program included activities to teach children sun protection skills, stimulating discussion on sun protection between adolescents and parents and supporting these discussions through instruction on effective parent-child communication. A recently reported sun protection intervention for families with children aged 9 to 12 years incorporated similar instructional and discussion activities, although tailored messaging was not used (Turrisi et al., 2006). Data from the present trial suggest that engaging families in theory-driven learning activities and discussions may promote improved sun protection. For example, among children greater engagement was related to more frequently wearing sunglasses and for parents engagement was associated with more

frequent sun protection of their child. Thus, the role of exposure to health communication messages (Hornik & Yanovitzky, 2003; Slater, 2004) in achieving health behavior change should be expanded from simply attracting children's and parents' attention to the sun protection messages to engaging participants in attractive, fun, and effective learning activities.

Conclusions about the effects of exposure and engagement effects are limited by the lack of random assignment to exposure levels. Random assignment would rule out spurious relationships created by unmeasured third variables causing both higher exposure or engagement and improved sun protection. Our analyses of demographic characteristics ruled out several such confounders. Randomization to exposure or engagement levels may not be possible without using highly controlled presentation methods that may not be possible in community interventions and that may severely limit external validity. Thus, future studies may need to rely on quasiexperimental methods to explore highly important questions on the effects of exposure and engagement with health messages.

In addition to low exposure and engagement, several additional reasons may account for the failure to detect differences across the main treatment conditions. First, the strength of the intervention may have been insufficient to modify well-established patterns of sun protection perceptions and behavior. The effects of the program became stronger with exposure and engagement, however, suggesting that the intervention was strong as designed. Second, the cognitive processing that gives tailored health messages their strength may not be attainable for adolescents. Additional work on the mechanisms underlying the effectiveness of tailoring has been called for, and application of these findings to adolescents may strengthen future tailored interventions targeting this population. (Campbell & Quintiliani, 2006; Kroeze, Werkman, & Brug, 2006).. Third, some scales had limited reliability (e.g., perceived barriers), which may have attenuated program effects. Fourth, statistical power may have been limited due to the lower than desired follow-up rates at posttest.

While the most rigorous test of this program suggested no effects on children and modest effects on parents, even limited exposure and engagement with the program improved sun protection for adolescents. Given the critical need to limit UV exposure as a means of reducing skin cancer risk, the targeting of adolescents and families with low-cost interventions is important and potentially efficacious. The findings in this study for exposure and engagement also may generalize beyond sun safety behaviors to interventions for other health behaviors (e.g., diet, injury prevention). Work is needed on strategies to maximize exposure and engagement with the content of health communication particularly in community settings where exposure is self-determined. It may be unrealistic to expect large effects from health communication programs that rely on channels that allow audience members a high degree of selective attention. Thus, even with techniques that maximize program exposure and engagement, family interventions should be one of several efforts in a comprehensive multichannel community approach to the primary prevention of skin cancer.

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Table 1

Demographic profile of student sample and comparison between treatment groups (summer program v. no summer program) at beginning of the summer

Variable		Overall (%)	Summer (%)	No Summer (%)
Gender	Male:	42.1	41.9	42.3
	N=589			
Race	Female:	57.9	58.1	57.7
	White	81.3	82.7	79.9
	N=528			
	Black	6.6	6.0	7.2
	American Indian	5.9	4.0	7.5
Ethnicity:	Asian	4.6	4.4	4.7
	Native Hawaiian	1.7	2.8	0.7
	Hispanic	18.8	18.5	19.1
	N = 584			
	Not Hispanic	81.2	81.5	80.9
Age	11	4.1	3.5	4.6
	N = 591			
	12	27.4	24.2	30.4
	13	46.0	50.9	41.5
	14	22.3	21.1	23.5
	15	0.2	0.4	0.0

Table 2

Association of self-reported summer program exposure with student and parent sun protection outcomes

	<u>Read 0</u>	<u>Read > 0</u>		
Outcome	Mean S.E.	Mean S.E.	F value P value D.F.	Effect Size
<i>Students</i>				
Used shade when outside for > 15 min. last month	3.5534 0.1539	3.0870 0.0818	7.04 0.009 1, 148	0.53
Number of burns received in the past month	1.8096 0.7410	0.1341 0.3694	4.08 0.05 1, 127	0.45
Knowledge	6.3669 0.3596	7.8057 0.1907	12.48 0.0006 1, 138	0.72
Sunscreens irritate the skin	2.5758 0.1767	1.9752 0.0914	9.08 0.003 1, 143	0.61
I don't like the way I look in a hat	2.9183 0.1763	2.5146 0.0940	4.08 0.05 1, 146	0.40
Self efficacy for using sunscreen with an SPF of 15 or greater	2.0446 0.1230	2.5344 0.0652	12.36 0.0006 1, 147	0.69
Self efficacy composite score	1.9120 0.0749	2.1295 0.0397	6.58 0.01 1, 147	0.51
<i>Parents</i>				
I see myself as the kind of person who lies out in the sun	2.6417 0.3253	1.6635 0.0688	8.65 0.004 1, 160	1.14
Self efficacy score	3.6613 0.1784	4.1214 0.0377	6.37 0.01 1, 160	0.98
Limited exposure to midday sun during past month	2.5230 0.4173	3.5022 0.0889	5.27 0.02 1, 158	0.89
Composite protection score during past month	2.9986 0.1885	3.4768 0.0399	6.16 0.01 1, 160	0.96
Apply sunscreen to arms	0.7071 0.1059	0.9265 0.0208	4.13 0.04 1, 156	0.85
Explained sun protection to children in past 3 months	0.5579 0.1167	0.8974 0.0247	8.10 0.005 1, 159	1.10

Table 3

Association of program engagement with student and parent self-reported sun protection outcomes

Outcome	Beta S.E.	F value P value D.F.
<i>Students</i>		
Wore sunglasses when outside for >15 minutes last month	-0.1825 0.0920	3.94 0.05 1,148
Sunscreens irritate the skin	-0.2195 0.0811	7.32 0.008 1, 146
Self-efficacy for using sunscreen with an SPF of 15 or greater	0.1574 0.0570	7.61 0.007 1, 150
Self-efficacy for wearing long sleeves & pants	0.1462 0.0555	6.93 0.009 1,150
Composite self-efficacy score	0.09429 0.0341	7.63 0.0071, 150
<i>Parents</i>		
It is easy to protect my children's skin from the sun	0.08585 0.0397	4.66 0.03 161
Composite self-efficacy score	0.05461 0.0183	8.85 0.003 162
When outside last month, how often did you wear sunglasses?	0.07549 0.0328	5.29 0.02 162
I plan to protect myself more from the sun next month	0.05911 0.0185	10.18 0.002 158
Frequency of putting SPF 15 or higher sunscreen on child last month	-0.1324 0.04530	8.54 0.004 157
Frequency of having child wear sunglasses last month	-0.1467 0.0406	13.00 0.0004 160
Composite score for child protection	-0.05574 0.0237	5.51 0.02 162
Plans to protect child from sun more frequently next month	0.03921 0.01951	4.04 0.05
Explained sun protection to children in past 3 months	0.03310 0.0124	7.08 0.008 161
Analyzed the amount of shade in the home in the past month	0.1582 0.0333	22.45 0.002 7