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A Randomized Trial of an Advanced Sun Safety Intervention for Vacationers at 41 North American Resorts

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Abstract

Taking vacations in sunny locations is associated with the development of skin cancer. This study tested a multi-component sun protection intervention based on diffusion of innovations theory and transportation theory designed to increase vacationers' comprehensive sun protection, i.e., use of clothing, hats, and shade and use, pre-application and reapplication of sunscreen. The trial enrolled 41 warm weather resorts in North America in a pair-matched group randomized pretest-posttest design and assessed samples of adult vacationers at resort outdoor recreation venues regarding sun protection at pretest (n=3,531) and posttest (n=3,226). While results showed no overall effect of the intervention on comprehensive sun protection across venues, the intervention produced statistically significant improvements in sun protection at waterside venues (pools and beaches). The intervention's overall effects may have been impeded by a lack of uniformly robust implementation, low interest in skin cancer prevention by guests, or shortcomings of the theories used to create prevention messages. The intervention may have worked best with guests in the highest-risk recreation venue, i.e., waterside recreation where they exposed the most skin. Alternative approaches that alter resort organizations, such as through changes in policy, environmental features, or occupational efforts might be more effective than targeting vacationers with behavior-change messages.

Introduction

Despite decades of research and public communication about the importance of sun protection, skin cancer remains a major international health problem (Lucas, McMichael, Smith, & Armstrong, 2006). In the United States, nearly 5 million new cases of skin cancer are reported annually, including nearly 90 thousand cases of melanoma, the deadliest skin

cancer (American Cancer Society, 2016). The leading cause of skin cancer, both melanoma and keratinocyte cancers, is excess exposure to ultraviolet radiation (UV) (American Cancer Society, 2016; Etzkorn et al., 2013; Green, Williams, Logan, & Strutton, 2011; Kricker et al., 2007; Ondrusova, Mrinakova, Ondrus, Polakova, & Durdik, 2013). Since skin cancer is largely preventable, new, advanced approaches are needed to promote routine sun protection.

Not surprisingly, vacationing at sunny venues near the summer solstice is highly associated with increased risk for sunburn and skin cancer. Research from the United States, Canada, Australia, and Europe found that travel to sunny vacation spots is associated with nevi that are precursors of melanoma (Bränström, Kristjansson, Dal, & Rodvall, 2006; Dulon et al., 2002; Newton-Bishop et al., 2010; Pettijohn et al., 2009; Silva et al., 2009). This undoubtedly is the result of the considerable sun exposure: Vacation venues are responsible for 25% of all sunburns (Boldeman et al., 2001) and vacationers are many times more likely to receive a sunburn than their stay-at-home counterparts (Køster, Thorgaard, Philip, & Clemmensen, 2011; Reinau et al., 2014). To illustrate, one study estimated that vacationing beachgoers received on average 500% more UV than required for a sunburn (O'Riordan, Steffen, Lunde, & Gies, 2008). Thus, vacationing increases the risk of all types of skin cancer, including melanoma (Agredano, Chan, Kimball, & Kimball, 2006; Claeson et al., 2012; Diaz & Nesbitt, 2013; Kricker et al., 2007; Ondrusova et al., 2013; Vlajinac et al., 2000; Vranova et al., 2012). While some community-based and occupational sun protection programs have had success in preventing excessive sun exposure and sunburning (Andersen et al., 2008; Andersen et al., 2012; Buller et al., 2005; Geller et al., 2001), recreational sun protection interventions have had mixed results (Dupuy, Dunant, & Grob, 2005; Pagoto, McChargue, & Fuqua, 2003; Pagoto, Schneider, Oleski, Bodenlos, & Ma, 2010; Roberts & Black, 2009; Segan, Borland, & Hill, 1999; Barbara J. Walkosz et al., 2014; Weinstock, Rossi, Redding, & Maddock, 2002; Winett et al., 1997; Zhou, Zhang, Knoll, & Schwarzer, 2015).

Sunscreen is the public's most common form of sun protection (Buller, Cokkinides, et al., 2011; Buller, Walkosz, Andersen, Scott, & Cutter, 2015; Detert et al., 2015); however, there are a number of complementary ways to prevent excessive sun exposure such as wearing a hat and protective clothing, utilizing shade, and staying indoors at midday. Unfortunately, sunscreen has been the exclusive focus of most campaigns rather than comprehensive sun safety (Cho, Hall, Kosmoski, Fox, & Mastin, 2010; Rodrigues, Sniehotta, & Araujo-Soares, 2013). Moreover, sunscreen preapplication and reapplication is essential to obtain maximum protection. Evidence also suggests that vacationers do not always attend to highly reliable cues indicating high UV levels when deciding whether to practice sun safety, most commonly relying on temperature, which is unreliable, and cloud cover (Andersen et al., 2016; Andersen et al., 2010). By contrast, time of day, season, latitude, and altitude are much more accurate indicators of UV intensity for vacationers (Buller et al., 2016) and should be emphasized by sun safety interventions.

An additional problem with prior sun protection interventions is that they relied on traditional rational cognitive behavior change theory (Bandura, 1986). For instance, our school-based and occupational sun protection interventions were constructed based on such principles. While showing promising effects (Andersen et al., 2012; Buller et al., 2005;

Buller et al., 2004; Buller et al., 2006), an alternative to such a traditional approach to skin cancer prevention involves using narrative messages. Transportation theory (TT) holds that narratives may be a powerful tool for behavior change. Vacationers' narratives may be about enjoyment, disinhibition, and escapism and typically do not include scripts for health and safety (Bellis, Hughes, & Lowey, 2002; Bellis, Hughes, Thomson, & Bennett, 2004; Bellis, Hughes, Dillon, Copeland, & Gates, 2007; Eiser & Ford, 1995; Sheng & Chen, 2013). Traditional cognitive behavior change theory erroneously suggests that risky behavior is related to ignorance and resistance to persuasive messages. Instead, TT suggests that integrating health narratives into vacationers' travel narratives can change sun protection behavior, avoid counter-arguing (Green & Brock, 2000, 2002; Slater, Buller, Waters, Archibeque, & LeBlanc, 2003), and more easily assimilate information by transporting vacationers into a narrative world (Green, 2006) where they identify with characters (Cohen, 2001) and shift normative beliefs about avoiding risks while vacationing. In addition to narrative elements, our approach uses principles of diffusion of innovations theory (Rogers, 2003) to elevate sun safety on vacationers' agendas, teach sun safety skills; convince vacationers that sun safety is compatible, easy, and advantageous, and motivate sun safety.

This study investigated the effectiveness of a sun protection intervention that advocated for a comprehensive approach to sun safety behavior, i.e., use of sunscreen, its pre-application and reapplication, wearing protective clothing and hats, finding shade, and being sensitive to environmental cues to UV radiation including latitude and time of day when deciding to take precautions. The intervention also incorporated narrative message formats. It was hypothesized that vacationers at resorts receiving the sun protection intervention would practice more sun protection than vacationers at control resorts not receiving the intervention. Recreation venues within resorts were explored as a potential moderator, because they influenced vacationers' sun protection at baseline (Walkosz et al., 2017).

Methods

Sample

Resorts.—A sample of 41 destination resorts in 17 states in the United States and one province in Canada were enrolled in the trial. Recruitment efforts sought resorts from lists obtained from two travel industry associations (American Hotel and Lodging Association and Hospitality Sales and Marketing Association International). Inclusion criteria for the resorts required the following: at least three outdoor recreation areas (golf course; court games, such as tennis; nature trails; etc.), one waterside (beach or pool) recreation area, on-site lodging, location in the United States or Canada, and agreement to participate. Because the recruitment rate was lower than expected, several ski areas were added from the National Ski Areas Association that also met the inclusion criteria for summer outdoor activities. The resorts provided a wide representation of geography, elevation, cost, and recreational activities. The list of resorts was randomly ordered by the project's biostatistician and the resorts were enrolled in two annual waves in 2012–13 and 2013–14 working from the top of the list.

Participants.—A total of 6,757 adult vacationers were surveyed and observed, 3,531 at pretest and another 3,226 at posttest (see CONSORT diagram in Figure 1). For both the pretest and posttest, vacationers 18 years of age and older were included in surveys on the assessment days at one of the outdoor recreation venues (e.g., beaches, pools, golf courses, tennis courts, activity areas, outdoor dining) between 10 am and 4 pm. Participants were read an informed consent statement by the interviewer. A second sample of adult vacationers was just unobtrusively observed at the resorts during the same data collection visits and results from that sample are reported elsewhere.(Buller et al., 2017)

Intervention

The intent of the *Go Sun Smart (GSS)* intervention was to promote comprehensive sun protection beyond the application of sunscreen. This included pre-application of SPF 15 or higher sunscreen a half hour before going outside and reapplication after two hours. In addition, the intervention encouraged guests to wear protective clothing, sunglasses, and a broad brim hat, seek shade, and stay out of the sun during the most intense UV hours of the day (10 am and 3 pm).

These more comprehensive sun safety practices were promoted through materials designed by the *GSS* project team based on the principles of diffusion of innovations theory and transportation theory. Ten different positive, gain-framed posters based were designed to be displayed indoors or outdoors. Some contained brief narratives elements recommending sun safety behaviors (e.g., photos of a family walking on a beach, woman shopping resort store selecting a hat, and couple sitting in the shade looking out at the ocean; newsreel showing photos of adults and children practicing sun safety; animated video depicting a story of a family checking into a resort, preparing to go outdoors; recreating outdoors, using sun protection, and ending by recounting their enjoyable day) (see Figure 2 for examples). Tip cards that provided a checklist format of the advanced sun safety behaviors were distributed in rooms, at check-in desks, and/or in brochure racks. *GSS* intervention materials also included a pre-arrival message and sun-safe packing list for email communication with guests, social media content, links to the *GSS* website for guests to access additional sun safety information, and a press release highlighting the resort's involvement with the *GSS* program for the health and well-being of their guests. Diffusion of innovation theory was employed in messages designed to teach sun safety skills (e.g., time of day and season when UV is high); convince vacationers that sun safety are compatible, easy, and advantageous (by modeling sun safety in vacation contexts), and create sun safety norms. A sample "script" was created to aid employees to recommend sun safety to vacationers. *GSS* appeals also were intended to shift normative beliefs about risks, especially severe sunburns, and remind vacationers to prepare to take precautions to address disinhibition while on vacations (Bellis et al., 2004; Bellis et al., 2007; Benotsch et al., 2007; Ragsdale, Difranceisco, & Pinkerton, 2006; Tutenges & Hesse, 2008).

A member of the *GSS* research team met with key resort managers and discussed implementation prior to deployment of intervention materials. They overviewed the program, introduced the intervention materials, reassured resort managers that these were all positive gain-framed messages, reviewed implementation recommendations, discussed how

to integrate the program within the resort, and addressed any potential barriers. Resort managers and staff were encouraged to make full use of intervention materials during the spring and summer intervention period.

Trial Design and Procedures

The sun safety intervention was assessed for effectiveness in a pair-matched group-randomized pretest-posttest design, with destination resorts as the units of randomization. Resorts were pair-matched within wave on latitude, elevation, mean annual sunshine hours, primary operational season (summer/winter), number of summer employees, and number of vacationers visiting the resort for just the day and at waterside recreation areas at pretest. The project biostatistician assigned one resort from each pair to either the GSS intervention or an untreated control group after pretesting. Independent cross-sectional samples of vacationers were assessed in outdoor recreation venues at each resort at pretest and posttest during two-day data collection visits, because most vacationers did not return to the same resort the second summer. The independent samples avoided internal validity threats of maturation, testing, and selection bias due to loss to follow-up (Buller et al., 2016; Campbell & Stanley, 1963). Almost all data collection visits were scheduled ± 3 months of the summer solstice (i.e., March 20 to September 20), when UV was highest. Visits occurred in the spring in semi-tropical and desert resorts where extremely high temperatures might keep visitors indoors in the summer. To protect against selection bias (e.g., due to convenience or attractiveness), research staff plotted a straight diagonal line across the venue (adjusting it for physical obstacles) and interviewed vacationers who were adjacent to that line. Also, surveys were conducted at both low-use and high-use recreation areas between 10 am and 4 pm ($\alpha 3$ hours of solar noon) on each day during the data collection visit. On a few days with either few vacationers available or periods of inclement weather, interviews were outside of those time frames. Interviews were conducted until the sample quotas were met or the two-day visit ended. Interviews were anonymous; rather, vacationers were identified by hotel/resort. Following pretesting in the first summer, the intervention was distributed to senior managers at intervention resorts who implemented it during the second spring/summer. Posttest assessments occurred during the second spring/summer, within ± 3 weeks of the pretest visit date to control seasonality effects. All procedures were approved by the San Diego State University and Quorum Institutional Review Boards.

Measures

Intercept Survey.—The intercept survey was modified from one used in previous research with vacationers at ski areas (Andersen et al., 2012; Walkosz et al., 2014; Walkosz et al., 2008). Vacationers were asked whether they were wearing sunscreen with SPF 15 or higher and, if so, what time they first applied it and if they had reapplied it. The time when they first went outdoors was recorded and used to estimate whether sunscreen was applied 15 minutes before going outside. Reapplication was defined as reapplying sunscreen if the vacationer was interviewed two hours after first applying it. Vacationers were asked the number sunburns that they had in the past 12 months and whether they had been sunburned during the current visit to the resort (defined as red and/or painful from exposure to the sun, following published guidelines (Lovato, Shoveller, & Mills, 1999)). Vacationers at both the control and the intervention resorts reported on exposure to sun protection communication

by recalling whether they had seen or heard any messages at the hotel/resort that advised them to protect their skin, lips, or eyes from the sun and, if so, where (i.e., poster or sign/brochure, pamphlet or flyer, hotel or resort website/social media). At posttest, vacationers at both intervention and control resorts indicated if they recognized the *GSS* logo. Vacationers' perceived importance of sun protection, injunctive norms for sun protection (i.e., "most people who matter to me think people should protect their skin from the sun"), and intention to sun tan were assessed with three 5-point Likert-type questions (strongly agree/strongly disagree). A fourth Likert-type question measured disinhibition during vacation ("I'm a different person when I'm on vacation than when I'm at home" (Benotsch et al., 2011)). Skin phenotype based on a validated measure of melanoma risk was measured combining eye color, skin tanning ability, and natural hair color (Kanetsky et al., 2006). Vacationers provided their home zip code (to determine latitude of home), date of first arrival at hotel/resort (if a member of a resort, date first arrived/year-round resident), age, education, Hispanic ethnicity, and race. Interviewers recorded the sex (male/female) of the vacationers, along with resort name, recreation venue, date, time interview began and ended, and interviewer's name.

After completing the survey, interviewers recorded vacationers' attire using an observation protocol modified from a measure used in Australia to assess sun protection in public venues (Dobbinson et al., 2014). They observed use of head covering (no hat/visor/narrow hat/baseball cap/legionnaire hat/wide-brimmed hat), sunglasses (yes/no), shirts (yes/no), sleeve length (strapless/sleeveless/¼ length/elbow length/¾ length/wrist length), collar (yes/no); neckline (low/high), midriff coverage (covered/exposed), leg covering (bikini or speedo/short shorts or skirt/mid-thigh/knee length/¾ cover/ankle length), socks (no socks/ankle length/calf length/knee length), and shoes (no shoes/sandals/shoes). These items were combined to estimate the percentage of skin covered, using Wallace's "rules of nine" clinical assessment of amount of burned skin area (Wallace, 1951). Observers also recorded whether the individual was in no shade, partial shade (25%/50%/75%), or full shade.

Four composite indices were created to measure sun protection practices. The first index was the overall average z-score for sunscreen use, sunscreen pre-application and reapplication, body coverage, and shade. The second index was the advanced sun protection average z-score for body coverage and shade only. The third composite index was a dichotomous score based on any sun protection, i.e., being in full shade **or** wearing 85% body coverage **or** wearing sunscreen +15 SPF. The fourth composite index was also a dichotomous score based on any advanced sun protection, i.e., full shade use **or** 85% body coverage.

Environmental Information on Resorts.—Research staff obtained environmental information for the data collection days. At the time of each survey, interviewers estimated cloud fraction by indicating if the sky was clear (0%), had high thin clouds, was partly cloudy, or was overcast (100%). For high thin clouds or partly cloudy, staff estimated the amount of sky covered by clouds in 10% increments (10% to 90%). The UV Index in 3-minute intervals and high temperature for the day were gathered from public databases from the closest weather station reported by weather.org or ground-based UV sensors in the U.S. Department of Agriculture's UV-B Monitoring and Research Program. The latitude and elevation of the resort was recorded.

Intervention Checklist.—Project staff scrutinized each resort during the visit for posttesting and recorded all sun safety messages observed on an implementation checklist (Buller et al., 2012). The number of GSS intervention items in use was calculated. This assessment was validated by the high correlation between staff records and those by a second project staff person who visited six resorts a second time and completed the checklist.(Buller et al., 2017) Vacationers also reported whether they recalled receiving a sun protection message at the resort in the survey.

Statistical Analyses

Changes in separate sun protection practices and composite sun protection indices from pretest to posttest were assessed between experimental conditions and level of intervention implementation. Models were fit by using analysis of covariance (ANCOVA) and controlling for guest demographics, resort characteristics, and environmental cues (identified by stepwise model selection at $p < 0.10$, two-tailed). PROC GLIMMIX was used for binary sun protection practices and PROC MIXED was employed for continuous sun protection practices. Potential moderation of experimental conditions by recreation venue was tested by examining the three-way interaction among venue (waterside v. non-waterside venue), experimental conditions, and pretest and posttest in the ANCOVA models. Potential moderation by recreation venue was also tested on program implementation using the same method. Alpha criterion levels were set at 0.05 (two-tailed) for all tests.

Results

Profile of the Posttest Sample of Guests

Table 1 presents the characteristics of the pretest and posttest cross-sectional samples of guests completing the intercept surveys. Vacationers were predominantly middle aged (mean age for pretest control group was 47.38, for pretest intervention group was 47.32, for posttest control group was 47.02, and for posttest intervention group was 47.3). There were more females than males; nearly 70% of guests had a college degree; most were non-Hispanic white; and about one quarter had skin types at high risk for melanoma (types 4 and 5).

A few differences between the pretest and posttest samples of vacationers emerged but the magnitude was small (Table 2). The posttest sample had more middle-aged respondents, more non-Hispanic white respondents, and more respondents with the highest risk skin types than the pretest sample. However, randomization largely balanced the experimental conditions on demographic characteristics (Table 1). There were more middle-aged adults, fewer young adults, more high school educated adults, and more non-Hispanic adults surveyed at the intervention than control resorts. However, these were small differences.

Assessment of Exposure to Go Sun Smart Intervention

Signal detection analyses employing Receiver Operator Characteristics (ROC) was used to identify the level of intervention implementation (assessed in the Intervention Checklist) that increased exposure of vacationers to *GSS* messages (i.e., message recall at posttest). This analysis produced a “decision tree,” which revealed that 9 *GSS* items (e.g., signs, posters, brochures, sun safety checklists) was the optimal cut-point for message recall. That is,

27.7% of vacationers at resorts with at least 9 *GSS* items recalled receiving a message telling them to protect their skin, lips or eyes from the sun at the resort, while only 16.8% of vacationers at resorts with less than 9 *GSS* items recalled such a sun safety message. This difference in recall was significant at $p < 0.01$. For the analysis of intervention implementation, resorts were regrouped into two groups, those with fewer than 9 *GSS* items and those with 9 or more *GSS* items in use.

Effect of Go Sun Smart Intervention on Sun Protection Practices

Intervention/Control Comparison.—Comparison of pre-post assessments of sun safety between intervention and control condition revealed no significant effects for the *GSS* intervention (Table 3). In fact, the only statistically significant difference was contrary to predictions: Vacationers at intervention resorts reported being sunburned more frequently in the past 12 months at posttest than pretest, while those at the control resorts reported fewer sunburns at posttest than at pretest.

Effect of Go Sun Smart Implementation.—The comparison of the extent of *GSS* implementation (<9 vs. 9 items) also failed to show an overall effect of the intervention. Only the any sun protection index (i.e., full shade use or 85% clothing coverage or SPF 15+ sunscreen use) demonstrated statistically significant pre-post differences (Table 3). Vacationers at resorts using 9 or more *GSS* items reported more sun protection practices on this index at posttest than pretest. By contrast, vacationers at resorts using fewer than 9 intervention items reported fewer sun protection practices at posttest than pretest.

Moderation of Intervention Effects by Recreation Area.

Significant moderation by recreation area emerged when comparing vacationers in waterside and non-waterside recreation areas. In general, at waterside recreation areas, *GSS* improved the sun protection practices of vacationers both when comparing intervention to control resorts (Table 4) and when examining the degree of intervention implementation (<9 vs. 9 items) (Table 4). The *GSS* intervention appeared to improve use of any sun protection behavior composite (i.e., full shade use or 85% clothing coverage or SPF 15+ sunscreen use) at waterside recreation areas compared to controls. At non-waterside recreation areas, there appeared to be little difference in this composite score. The remaining statistically significant moderation effects of recreation area on the intervention/control comparison did not show improvement over controls. However, *GSS* had more positive impact on all four sun protection composite scores when implemented with greater fidelity (i.e., 9 items) compared to lower fidelity (<9 items) in waterside recreation areas (Table 4). There was also some evidence that *GSS* was more effective with the composite measures in the non-waterside recreation areas at resorts implementing more rather than less intervention items, although these differences were smaller. Amount of shade used by vacationers was also greater at waterside recreation areas in the resorts implementing 9 or more *GSS* items compared to fewer than 9 items.

Discussion

The most positive result of the *GSS* resort intervention was that it was effective at waterside recreation venues. While *GSS* did not have an overall impact throughout the resorts, *GSS* showed a significant moderation effect such that a positive effect of the intervention was observed at pools, beaches and marinas. This moderation effect emerged both in the comparison between intervention and control and between low and high fidelity implementation groups. Our baseline observations prior to the intervention showed that vacationers at waterside venues had more high-risk sun exposure (i.e., they were wearing less clothing) than golfers, tennis players, diners, and individuals at other non-waterside venues (Walkosz et al., 2017). The large amounts of skin exposed to the sun may have made vacationers feel vulnerable to sun damage and thus made the sun protection messages more salient at these waterside venues. Our confidence in the success of *GSS* at the waterside recreation venues is increased by the fact that a similar effect moderation of waterside venues was seen in a second sample of adult vacationers at the resorts who were simply observed and not interviewed (Buller et al., 2017). Combined, it appears that the greatest payoff for making progress on vacationers' sun protection behavior with *GSS* may be at waterside venues, where our intervention worked best and vacationers are most exposed to the sun.

Unfortunately, across all resort venues, the primary analysis showed no overall effect of the intervention resorts compared to the control resorts on comprehensive sun protection at warm weather resorts, contrary to the main hypothesis. There also was no difference by condition in the companion sample of vacationers who were just observed (Buller et al., 2017). This may have occurred for several reasons. Some of the resorts may have had low interest in sun protection and thus may not have delivered the intervention with high fidelity. It took our team over 6 months to recruit the sample of 41 resorts and only 17% of the resorts contacted agreed to participate. Moreover, some resort managers indicated that their "product," i.e. selling recreation in the sunshine, was inconsistent with the sun protection messages (even positive "gain frame" messages employed in this study), suggesting that like indoor tanning salons, some resorts are in the business of selling high-risk UV exposure. Perhaps as a consequence, several resorts did a poor job of implementing the intervention. Second, vacationers are a transient population and may receive limited exposure to intervention materials, unlike residents of a community or employees who can receive repeated exposure to intervention materials. Third, the use of brief narrative messages, despite augmenting them with diffusion of innovations theory principles, may not have been effective. Narrative messages used in the study were short; the story had to be told in a brief message or single sign, poster, or card. This may have limited the impact of the transportation effect, i.e., reducing counter arguing and increasing identification (Green, 2006; Green & Brock, 2000). Fourth, the resorts may have attracted a clientele that was highly disinhibited while vacationing, and/or many of these individuals simply do not care about sunburn or skin cancer while on vacation. Prior research suggests that unsafe sex, drug-use, and excess alcohol consumption are risky and disinhibited behaviors that are common among vacationers (Bellis et al., 2002; Bellis et al., 2004; Benotsch et al., 2007; Eiser & Ford, 1995). Also, having "a little color" from a sunburn or sun tan when one

returns to work may actually be a status symbol. Fifth, the intervention may have made vacationers more alert to sunburns, even mild ones, causing vacationers in the intervention group to report more sunburns. Finally, vacationers dining, playing golf or tennis and at other non-waterside venues were required attire covering more of their skin, with little variation that covered more of the skin than vacationers at waterside venues. This might have made it more difficult for vacationers to increase their sun protection at non-waterside venues, although not entirely (e.g., golfers could wear long pants or wide-brimmed hats). Moreover, these venues may offer more opportunities to use shade from umbrella-covered tables, awnings over benches, and covers on golf carts, making vacationers feel that they already were sufficiently protected and did not need to take more precautions. Given these results in a large multi-site study, new approaches to reach vacationers appear to be needed, both at the organizational level to convince resort managers that sun protection promotion is in their best interest and at the individual level to reach vacationers with convincing sun safety messages that overcome resistance and disinhibition tendencies on vacation.

The failure of the intervention across all resort venues on sun safety was particularly disappointing in light of the significant strengths of the study. First, the large number of resorts was diverse in location and type, from beaches to lakes to mountains and across public, private, middle class, and luxury types. Second, the group randomized pretest-posttest randomized design provided ecological validity, avoiding many threats to internal validity. Third, unlike many sun protection studies that rely only on anticipated behavior or retrospective recollection, this study observed the actual sun safety behavior related to hats, clothing and shade and obtained reports of sunscreen behavior in real time. Finally, the study focused on a comprehensive taxonomy of sun safety behaviors both in the intervention and measurement, including clothing, hats, time of day, use of shade, and sunscreen application, pre-application, and reapplication.

The study was not without some limitations. The measures of sunscreen and sunburn relied on self-reports that are subject to potential reporting biases. The aforementioned problems with an inconsistent implementation of the intervention across resorts, while providing an effectiveness test of an invention in actual field settings, sacrificed some experimental control and may not have been the strongest test of the intervention compared with an efficacy trial design. Moreover, the level of implementation was not randomly assigned, so the analyses of implementation levels were subject to third-variable effects, which we tried to control by including covariates. The low recruitment rate of the resorts may have made the sample less representative. The management of the resorts that rejected our study or failed to respond to our invitations were probably even less motivated to provide sun protection for their guests than the management of the resorts in this study. Finally, using a combination of an intercept survey and behavioral observation, while providing comprehensive measurement of sun protection, could have biased the results because they were not truly unobtrusive.

It is imperative to find effective methods of promoting sun protection to reach the skin cancer prevention goals identified recently by the U.S. Surgeon General (Office of the Surgeon General, 2014) including for vacationers who often receive high-risk sun exposure. Given the limited effectiveness of directly intervening with individuals, an alternative

approach may be to address policy and environmental features of resorts. Studies of school and occupational sun safety have found that senior managers can be convinced to adopt sun protection policies (Buller, Walkosz, Buller, & Wallis, 2015, December; Buller, Reynolds, et al., 2011), which could overcome detrimental effects of management turnover or varied commitment of managers to sun safety. Encouraging resorts to provide shade structure also may attract vacationers to use shaded areas (Dobbinson et al., 2014; Dobbinson et al., 2009). Another approach is to work initially with resort management associations or resort professional associations on occupational sun protection, for workplace safety may receive less initial resistance than interventions targeting resort clientele. Once convinced to improve occupational sun safety, managers may recognize that guests also need to be protected and would be willing to provide adequate shade structures, have the staff work with guests to prevent excessive sun exposure, and provide guests with sunscreen as part of the in-room complementary toiletries or at resort shops. A final alternative approach would be to work with resorts, airlines, cruise ships, and Internet travel sites to promote sun protection before guests depart for vacation; this might facilitate the packing of sunscreen and protective clothing prior to departure and interfere less with resort operations.

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Figure 1.
CONSORT diagram.

Figure 2.
Examples of *Go Sun Smart* signage with narrative elements.

Table 1:

Demographics of Resort Guests by Experimental Conditions in Intercept Surveys

		Intercept Surveys		
Guest Demographics		Overall n=3531	Control n=1701	Intervention n=1830
<i>Pretest</i>				
Age				
	18–34	20.4%	22.4%	18.5% **
	35–60	58.2%	54.5%	61.5%
	60+	21.4%	23.1%	20.0%
Gender				
	Female	61.2%	59.8%	62.4%
	Male	38.8%	40.2%	37.6%
Education				
	High school or less	10.6%	10.8%	10.5%
	Technical education or some college	21.1%	21.3%	20.9%
	4-year college graduate	40.8%	39.5%	41.9%
	Postgraduate degree	27.5%	28.4%	26.7%
Ethnicity and race				
	Non-Hispanic White	93.1%	93.4%	92.9%
	Other	6.9%	6.6%	7.1%
Skin phenotype				
	Darkest skin and lowest risk – 1	19.0%	19.1%	18.9%
	2	24.9%	24.7%	25.0%
	3	33.7%	34.0%	33.3%
	4	20.3%	19.8%	20.8%
	Lightest skin and highest risk – 5	2.1%	2.4%	2.0%
<i>Posttest</i>				
Age				
	18–34	19.6%	22.0%	17.2% **
	35–60	61.1%	58.6%	63.5%
	60+	19.3%	19.4%	19.3%
Gender				
	Female	61.0%	60.2%	61.7%
	Male	39.0%	39.8%	38.3%
Education				
	High school or less	11.0%	9.3%	12.6% *
	Technical education or some college	20.2%	20.3%	20.1%
	4-year college graduate	40.8%	41.8%	39.8%
	Postgraduate degree	28.0%	28.6%	27.5%
Ethnicity and race				
	Non-Hispanic White	91.6%	90.5%	92.7% *
	Other	8.4%	9.5%	7.3%

Guest Demographics	Intercept Surveys		
	Overall n=3531	Control n=1701	Intervention n=1830
Skin phenotype			
Darkest skin and lowest risk – 1	19.8%	20.3%	19.4%
2	25.0%	24.9%	25.1%
3	30.2%	30.9%	29.4%
4	22.5%	21.7%	23.2%
Lightest skin and highest risk – 5	2.5%	2.2%	2.9%

*
p<0.05.

**
p<0.01.

Table 2.

Demographics of Resort Guests at Pretest and Posttest in Intercept Surveys

Guest Demographics	Intercept Surveys		
	Overall n=6757	Pretest n=3531	Posttest n=3226
Age			
18–34	20.0%	20.4%	19.6% *
35–60	59.6%	58.2%	61.1%
60+	20.4%	21.4%	19.3%
Gender			
Female	61.1%	61.2%	61.0%
Male	38.9%	38.8%	39.0%
Education			
High school or less	10.8%	10.6%	11.0%
Technical education or some college	20.7%	21.1%	20.2%
4-year college graduate	40.8%	40.8%	40.8%
Postgraduate degree	27.7%	27.5%	28.0%
Ethnicity and race			
Non-Hispanic White	92.4%	91.6%	93.1% *
Other	7.6%	8.4%	6.9%
Skin phenotype			
Darkest skin and lowest risk – 1	19.4%	19.0%	19.8% *
2	24.9%	24.8%	25.0%
3	32.0%	33.7%	30.2%
4	21.3%	20.3%	22.5%
Lightest skin and highest risk – 5	2.4%	2.2%	2.5%

*
p<0.05.**
p<0.01.

Table 3.

Sun Protection Behaviors by Experimental Conditions and Program Implementation at Pretest and Posttest

Sun Protection Behaviors	Experimental Condition			
	Control		Intervention	
	Pretest	Posttest	Pretest	Posttest
Are you wearing a sunscreen with an SPF of 15 or higher on your skin, today? <i>1, 3, 4, 6, 8, 9, 10, 12, 15, 16, 17, 18, 19, 20</i>	62.9%	53.8%	55.8%	53.8%
Did you first apply sunscreen 15 minutes or more before you first went out? <i>1, 2, 3, 8, 12, 16</i>	42.3%	40.5%	40.4%	35.5%
Did the guest reapply sunscreen correctly? (Either reapplied sunscreen or didn't need to reapply sunscreen within 2 hours)? <i>1, 2, 8, 15, 16, 17, 18, 20</i>	67.1%	69.1%	64.6%	70.6%
Body coverage score, <i>1, 2, 3, 5, 6, 7, 8, 9, 11, 15, 16, 17, 18, 19</i>	0.61	0.62	0.63	0.63
Percent of shade use, <i>1, 2, 3, 6, 8, 10, 11, 15, 17, 18, 19, 20</i>	0.35	0.32	0.33	0.32
Mean of z scores for sun protection index: sun screen of SPF 15+, pre-application, reapplication (no vs. yes), body cover score, and percent of shade <i>1, 2, 3, 4, 6, 8, 12, 16, 17, 18</i>	-1.85	-0.90	-2.18	-0.41
Mean of z scores for advanced sun protection index: body cover score and percent of shade <i>1, 2, 3, 5, 6, 7, 8, 13, 15, 16, 18, 20</i>	4.30	2.87	7.19	4.71
Sun protection index (full shade use, or body coverage score 0.85, or sunscreen with an SPF 15+) <i>1, 2, 3, 4, 6, 9, 10, 12, 14, 15, 16, 17, 18</i>	78.4%	70.9%	73.2%	71.5%
Sun protection index (full shade use or body coverage score 0.85) <i>1, 2, 5, 6, 8, 9, 15, 16, 17, 18, 20</i>	34.9%	31.1%	33.1%	34.9%
Has your skin been ned in the past 12 months? <i>1, 2, 3, 5, 6, 7, 8, 9, 11, 12, 16, 19</i>	41.3%	35.3%	34.6%	38.7% *
Has your skin been sunburned while recreating outdoors during your time at this hotel or resort? <i>1, 2, 5, 16, 17</i>	5.3%	4.3%	3.9%	4.7%
	Program Implementation			
	<9 GSS Items		9 GSS Items	
	Pretest	Posttest	Pretest	Posttest
Are you wearing a sunscreen with an SPF of 15 or higher on your skin, today? <i>1, 3, 4, 6, 8, 9, 10, 12, 15, 16, 17, 18, 19, 20</i>	61.7%	54.1%	53.2%	52.8%
Did you first apply sunscreen 15 minutes or more before you first went out? <i>1, 2, 3, 8, 12, 16</i>	41.6%	38.8%	40.2%	35.2%
Did the guest reapply sunscreen correctly? (Either reapplied sunscreen or didn't need to reapply sunscreen within 2 hours)? <i>1, 2, 8, 15, 16, 17, 18, 20</i>	68.5%	70.2%	58.2%	69.2%
Body coverage score, <i>1, 2, 3, 5, 6, 7, 8, 9, 11, 15, 16, 17, 18, 19</i>	0.61	0.62	0.65	0.65
Percent of shade use, <i>1, 2, 3, 6, 8, 10, 11, 15, 17, 18, 19, 20</i>	0.34	0.32	0.33	0.34
Mean of z scores for sun protection index: sun screen of SPF 15+, pre-application, reapplication (no vs. yes), body cover score, and percent of shade <i>1, 2, 3, 4, 6, 8, 12, 16, 17, 18</i>	-1.56	-1.25	-3.37	1.12
Mean of z scores for advanced sun protection index: body cover score and percent of shade <i>1, 2, 3, 5, 6, 7, 8, 13, 15, 16, 18, 20</i>	4.36	1.91	3.14	9.58
Sun protection index (full shade use, or body coverage score 0.85, or sunscreen with an SPF 15+) <i>1, 2, 3, 4, 6, 9, 10, 12, 14, 15, 16, 17, 18</i>	76.8%	69.5%	73.3%	76.1% *
Sun protection index (full shade use or body coverage score 0.85) <i>1, 2, 5, 6, 8, 9, 15, 16, 17, 18, 20</i>	33.4%	29.9%	36.1%	42.8%
Has your skin been sunburned in the past 12 months? <i>1, 2, 3, 5, 6, 7, 8, 9, 11, 12, 16, 19</i>	39.8%	36.2%	33.1%	39.0%

Sun Protection Behaviors	Experimental Condition			
	Control		Intervention	
	Pretest	Posttest	Pretest	Posttest
Has your skin been sunburned while recreating outdoors during your time at this hotel or resort? <i>1, 2, 5, 16, 17</i>	4.8%	4.3%	3.9%	5.1%

Covariates controlled in the model:

¹Resort enrollment wave

²Age

³Gender

⁴Education

⁵Ethnicity and race

⁶Skin phenotype

⁷Do you agree or disagree that you are a different person when you're on vacation than when you're at home?

⁸Recreation Area (swimming pool and private beach vs. others)

⁹Resort use (low vs. high)

¹⁰Percent of water recreation at the resort

¹¹Annual sunshine hours at the resort

¹²Summer resort or winter resort

¹³Number of summer employees at the resort

¹⁴Proximity to summer solstice

¹⁵Proximity to noon

¹⁶Elevation

¹⁷Latitude

¹⁸Cloud cover

¹⁹Maximum temperature on the visit date (F)

²⁰UV Index.

*
p<0.05.

Table 4.

Moderation Effects of Recreation Venues (non-waterside vs. waterside) on Sun Protection Behaviors by Experimental Conditions and Intervention Implementation at Pretest and Posttest

	Experimental Condition					
	Control			Intervention		
	Non-waterside	Waterside		Non-waterside	Waterside	
Sun Protection Behaviors						
Are you wearing a sunscreen with an SPF of 15 or higher on your skin, today? <i>1, 3, 4, 6, 8, 9, 10, 12, 15, 16, 17, 18, 19, 20</i>	Pretest 59.2%	Posttest 53.2%		Pretest 50.9%	Posttest 48.2%	Posttest 59.8%
Did you first apply sunscreen 15 minutes or more before you first went out? <i>1, 2, 3, 8, 12, 16</i>	49.1%	47.3%		46.5%	44.3%	34.5%
Did the guest reapply sunscreen correctly? (Either reapplied sunscreen or didn't need to reapply sunscreen within 2 hours)? <i>1, 2, 8, 15, 16, 17, 18, 20</i>	50.3%	55.4%		53.0%	56.5%	81.6%
Body coverage score, <i>1, 2, 3, 5, 6, 7, 8, 9, 11, 15, 16, 17, 18, 19</i>	0.72	0.73	0.51	0.72	0.72	0.55
Percent of shade use <i>1, 2, 3, 6, 8, 10, 11, 15, 17, 18, 19, 20</i>	0.42	0.38	0.28	0.35	0.36	0.32
Mean of z scores for sun protection index: sun screen of SPF 15+, pre-application, reapplication (no vs. yes), body cover score, and percent of shade <i>1, 2, 3, 4, 6, 8, 12, 16, 17, 18</i>	6.52	0.68	-9.35	2.45	0.98	-7.06
Mean of z scores for advanced sun protection index: body cover score and percent of shade <i>1, 2, 3, 5, 6, 7, 8, 13, 15, 16, 18, 20</i>	23.75	21.47	-14.47	19.80	19.13	-4.88
Sun protection index (full shade use, or body coverage score 0.85, or sunscreen with an SPF 15+) <i>1, 2, 3, 4, 6, 9, 10, 12, 14, 15, 16, 17, 18</i>	79.8%	74.6%	76.7%	71.4%	69.8%	75.4%
Sun protection index (full shade use or body coverage score 0.85) <i>1, 2, 5, 6, 8, 9, 15, 16, 17, 18, 20</i>	47.1%	42.6%	24.2%	41.3%	41.8%	26.6%
Has your skin been sunburned in the past 12 months? <i>1, 2, 3, 5, 6, 7, 8, 9, 11, 12, 16, 19</i>	42.7%	38.9%	39.9%	35.1%	39.1%	34.4%
Has your skin been sunburned while recreating outdoors during your time at this hotel or resort? <i>1, 2, 5, 16, 17</i>	5.0%	3.9%	5.5%	3.2%	3.5%	4.4%
Program Implementation						
	<9 GSS Items			>=9 GSS Items		
	Non-waterside	Waterside		Non-waterside	Waterside	
Are you wearing a sunscreen with an SPF of 15 or higher on your skin, today? <i>1, 3, 4, 6, 8, 9, 10, 12, 15, 16, 17, 18, 19, 20</i>	Pretest 56.1%	Posttest 51.9%		Pretest 51.7%	Posttest 47.6%	Posttest 59.5%
Did you first apply sunscreen 15 minutes or more before you first went out? <i>1, 2, 3, 8, 12, 16</i>	45.3%	45.8%	37.9%	53.1%	44.5%	26.9%

	Sun Protection Behaviors	Experimental Condition					
		Control			Intervention		
		Non-waterside	Waterside	Non-waterside	Waterside	Waterside	
		Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
Did the guest reapply sunscreen correctly? (Either reapplied sunscreen or didn't need to reapply sunscreen within 2 hours)?	<i>1, 2, 8, 15, 16, 17, 18, 20</i>	57.3%	58.1%	77.6%	79.4%	76.3%	84.1%*
Body coverage score,	<i>1, 2, 3, 5, 6, 7, 8, 9, 11, 15, 16, 17, 18, 19</i>	0.71	0.71	0.51	0.52	0.73	0.57
Percent of shade use,	<i>1, 2, 3, 6, 8, 10, 11, 15, 17, 18, 19, 20</i>	0.38	0.38	0.30	0.25	0.37	0.35*
Mean of z scores for sun protection index: sun screen of SPF 15+, pre-application, reapplication (no vs. yes), body cover score, and percent of shade	<i>1, 2, 3, 4, 6, 8, 12, 16, 17, 18</i>	4.76	0.35	-7.62	-2.81	2.27	-9.58
Mean of z scores for advanced sun protection index: body cover score and percent of shade	<i>1, 2, 3, 5, 6, 7, 8, 13, 15, 16, 18, 20</i>	20.85	19.04	-12.27	-15.56	22.56	-3.17*
Sun protection index (full shade use, or body coverage score	<i>1, 2, 3, 4, 6, 9, 10, 12, 14, 15, 16, 17, 18</i>	76.2%	71.6%	77.4%	67.3%	73.9%	74.0%
Sun protection index (full shade use or body coverage score	<i>1, 2, 5, 6, 8, 9, 15, 16, 17, 18, 20</i>	44.2%	40.6%	24.0%	20.7%	44.6%	41.9%*
Has your skin been sunburned in the past 12 months?	<i>1, 2, 3, 5, 6, 7, 8, 9, 11, 12, 16, 19</i>	40.9%	38.1%	38.7%	34.4%	33.3%	37.9%
Has your skin been sunburned while recreating outdoors during your time at this hotel or resort?	<i>1, 2, 5, 16, 17</i>	4.6%	3.8%	5.0%	4.8%	2.7%	7.5%

Note. Non-waterside venues included outdoor dining, court and lawn games, golf courses, marina, activity areas, commons and reception, and other venues. Waterside venues included swimming pools and private beaches.

Covariates controlled in the model:

¹ Resort enrollment wave

² Age

³ Gender

⁴ Education

⁵ Ethnicity and race

⁶ Skin phenotype

⁷ Do you agree or disagree that you are a different person when you're on vacation than when you're at home?

⁸ Recreation Area (swimming pool and private beach vs. others)

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- ⁹Resort use (low vs. high)
- ¹⁰Percent of water recreation at the resort
- ¹¹Annual sunshine hours at the resort
- ¹²Summer resort or winter resort
- ¹³Number of summer employees at the resort
- ¹⁴Proximity to summer solstice
- ¹⁵Proximity to noon
- ¹⁶Elevation
- ¹⁷Latitude
- ¹⁸Cloud cover
- ¹⁹Maximum temperature on the visit date (F)
- ²⁰UV Index.
- ^{*}p<0.05
- ^{**}p<0.01