Effects of UV Photographs, Photoaging Information, and Use of Sunless Tanning Lotion on Sun Protection Behaviors

Heike I. M. Mahler, PhD; James A. Kulik, PhD; Jody Harrell, MA; Alma Correa, BA; Frederick X. Gibbons, PhD; Meg Gerrard, PhD

Objectives: To examine the efficacy of UV photographs and information about photoaging (eg, wrinkles and age spots) for increasing the sun protection intentions and behaviors of young adults and to determine whether any effects of this appearance-based intervention could be enhanced by providing a non-UV alternative for achieving a tan (ie, sunless tanning lotion).

Design: Randomized control trial with 1-month follow-up.

Setting: Two universities in Southern California.

Participants: A volunteer sample of 146 college students, 91.1% of whom completed the “surprise” 1-month follow-up.

Intervention: A UV facial photograph and a brief videotape describing the causes and consequences of photoaging. The study tested the effects of the photoaging information/UV photographic intervention only, the intervention plus use of sunless tanning lotion, and a control condition.

Main Outcome Measures: Participants sun protection intentions as assessed immediately after the intervention and sun protection behaviors during the month after the intervention as assessed during a surprise telephone follow-up.

Results: The intervention resulted in significantly stronger sun protection intentions (P < .001) and greater sun protection behaviors (P < .05) relative to controls. Furthermore, the group that also used sunless tanning lotion tended to engage in greater sun protection behaviors than the group that received the intervention alone (P < .08).

Conclusion: The UV photographic intervention holds promise as a cost-effective approach to motivate practices that may ultimately result in health benefits (ie, reduced skin cancer rates).

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The incidence of new skin cancer cases is increasing at a rate of 3% to 4% per year, and the incidence of the most deadly form of skin cancer (melanoma) is increasing more rapidly than that of any other type of cancer. It is widely recognized that most skin cancer cases could be prevented. Prevention behaviors include limiting sun exposure during midday hours (10 AM–3 PM [formerly 10 AM–2 PM]), wearing protective clothing, and wearing sunscreen with a solar protection factor (SPF) of at least 15. For the past several decades, researchers across various disciplines have sought to understand the mechanisms underlying sun exposure and sun protection beh-

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behavior. Although public education programs and media attention have succeeded in raising awareness of the health risks (skin cancer) of UV exposure, health-based education interventions have been considerably less successful at motivating behavioral change. Young adults in particular, motivated by the perceived appearance-enhancing benefits of tanned skin, are continuing to receive large amounts of intentional and unintentional exposure to UV radiation. In this population, the possibility of developing skin cancer in the distant future may not weigh as heavily in behavioral decision-making as the certainty of improving physical appearance immediately.

Interventions that address individuals’ concerns about appearance may be more effective than health warnings alone for countering the strong normative influences for tanning. A small but growing body of work suggests that an effective strategy might be to emphasize that UV exposure can have negative consequences for appearance (eg, wrinkles and age spots). For example, Mahler et al® made the negative appearance consequences of UV exposure more salient, certain, and immediate for individuals by showing them a photograph of their own faces taken with a UV filter, which depicted nonuniform epidermal pigmentation caused by chronic UV exposure. Both college students and beach patrons who viewed their UV photographs expressed greater sun protection intentions than did controls. Furthermore, in a 1-month follow-up conducted with the beach patrons, those who had viewed their UV photographs reported engaging in greater sun protection behaviors than did controls. While these initial results are promising, we must be able to replicate them. Also, the beach patrons in Mahler et al® were aware that a follow-up would be conducted, and so they may have altered their behaviors in anticipation of the follow-up.

One purpose of the present study was to determine whether the findings of Mahler et al® could be replicated when participants were unaware that they would be contacted for follow-up. In addition, we sought to determine whether the effects of the UV photographic intervention could be enhanced by offering individuals an alternative method of obtaining a tan: a sunless tanning lotion. The assumption was that sunless tanning lotion is an effective low-risk alternative to UV exposure that can produce the same appearance benefits associated with actual UV exposure. Thus, based on the Theory of Alternative Behaviors, increasing individuals’ perceptions of the risks of UV exposure while simultaneously presenting them with a viable alternative for obtaining a tan should be particularly effective in changing sun protection behaviors.

We expected that receiving photoaging information and viewing a UV facial photograph would result in increased sun protection intentions and behaviors. We also hypothesized that the intervention would affect several perceptions regarding photoaging and sun protection. Specifically, we expected that the intervention would result in lower perceived costs of sun protection and rewards of sun exposure and greater perceived susceptibility to photoaging, severity of photoaging, efficacy of sun protection for the prevention of photoaging, and self-efficacy for using sunscreen regularly. Finally, we hypothesized that individuals who received the intervention plus a sunless tanner sample would display the greatest sun protection intentions and behavior.

STUDY POPULATION AND PROCEDURES

The study population consisted of 54 undergraduates from the University of California, San Diego (41 women and 13 men) and 92 undergraduates from California State University, San Marcos (73 women and 19 men). Participants signed up for a study titled simply “Health Attitudes” in partial fulfillment of requirements for introductory psychology courses at both institutions.

Participants were run individually or in pairs (separated by a partition). The condition to be run during each session was determined at the beginning of the data collection period using a block randomization procedure. After providing written informed consent, all participants completed the first questionnaire that assessed demographic information and baseline sunbathing and sun protection behaviors. Thereafter, individuals in the control group proceeded directly to a second questionnaire designed to assess future intentions to use sunscreen and several measures of their perceptions of photoaging and sun protection.

Prior to completing the second questionnaire, participants in the intervention groups viewed the photoaging video and had their UV photographs taken and shown to them. Immediately after the intervention and before they completed the second questionnaire, participants in the intervention plus sunless tanner sample group received a 6-oz (177-mL) bottle of either Neutrogena (Los Angeles, Calif) or SkinMedica (Encinitas, Calif) sunless tanning lotion containing dihydroxyacetone. The experimenter explained to these participants how to use sunless tanning lotion, stated that using sunless Tanner is the only safe way to get a tan, and informed participants that sunless tanning lotion does not provide sun protection.

At the end of the session, all participants were provided with a sunscreen sample, ostensibly as a thank you gift for participating in the study. The study procedures were approved by the institutional review board at each institution.

UV PHOTOGRAPHIC AND PHOTOAGING INFORMATION INTERVENTION

The intervention consisted of a 12-minute video and a UV facial photograph taken with an instant camera. The video defined photoaging (premature wrinkles and age spots due to UV radiation) and discussed ways to reduce the effects of UV exposure (using a sunscreen with an SPF of at least 15 and avoiding the sun between the hours of 10 AM and 2 PM). The video also provided general information about sunscreen, for example, explaining what the SPF means and how much sunscreen to use.

The UV facial photographs were taken with a single-lens reflex camera equipped with Polaroid 667 professional black-and-white instant film (Waltham, Mass) and a UV filter. This filtered UV light is absorbed by the melanin in the skin. The resulting black and white photograph highlights clearly and dramatically the nonuniform epidermal pigmentation that has resulted from chronic sun exposure. Each person who had a UV photograph taken also had a natural-light instant photograph taken for comparison. In all cases, the natural-light black and white photograph was shown to participants first, fol-
lowed by the UV photograph. Participants were told that any “dark, freckled, or pitted areas” in the UV photograph (that did not appear in the natural-light photograph) indicated existing underlying skin damage that would continue to worsen if they did not engage in greater sun protection behaviors (than they currently did).

MEASURES AND SCALES

Baseline UV exposure and protection assessment included self-reports of (1) number of hours sunbathing during the previous weekend; (2) number of hours spent in the sun doing activities other than sunbathing during the previous week and weekend, respectively; (3) frequency of sunscreen use on face and body (on a 0% to 100% scale) while sunbathing and, separately, while doing other activities in the sun; and (4) SPF level of sunscreen used on face and body while sunbathing and, separately, when doing other outdoor activities.

Nine items, rated on separate 5-point scales (1, strongly disagree–5, strongly agree), assessed intentions to use sunscreen in the future (eg, “I plan to use sunscreen on my face more frequently when I sunbathe” or “I plan to use sunscreen on all exposed areas of my body on a daily basis”). As in previous work,15,20 these 9 items displayed high internal consistency (Cronbach’s α = 0.92), and therefore they were averaged into an intentions index for analyses.

Several short scales were developed to assess participants’ phototaging and sun protection perceptions. Most of the specific items for these scales were derived from previous studies on sun protection,15,16 and all have been used successfully in previous work by our team.15,20 Participants indicated their level of agreement with each item on separate 5-point scales (1, strongly disagree–5, strongly agree). The perceived rewards of sunbathing protection of the severity of photoaging (α = 0.79; eg, “I care about looking younger and healthier” or “My current level of skin protection is adequate”). Perceived susceptibility to sunbathing of being tan was assessed with 10 items (α = 0.89; eg, “I think I look healthier when I have a tan”). Twelve items assessed perceptions of the severity of photoaging (α = 0.79; eg, “It is too nice during the summer to avoid going out between 10 AM and 2 PM”). Perceived susceptibility to phototaging was assessed with 8 items (α = 0.77; eg, “It would be too terrible to have wrinkles on my face”). Perceived response efficacy of sunscreen use for the prevention of phototaging was assessed with 4 items (α = 0.69; eg, “Whether people develop wrinkles and age spots is directly related to how frequently they use sunscreen when spending time in the sun”). Finally, to assess self-efficacy, for regular sunscreen use, participants indicated on 12 separate 10-point scales (1, certain I could not do to 10, certain I could do) how confident they were that they could motivate themselves to use sunscreen despite obstacles (α = 0.92; eg, “Use sunscreen even when I’m feeling too lazy to bother with it”). This self-efficacy measure was based closely on similar measures used successfully by researchers in other domains.28,29

TELEPHONE FOLLOW-UP PROCEDURES AND MEASURES

Approximately 1 month after the intervention (mean [SD] follow-up, 27.36 [7.42] days), participants were unexpectedly contacted by telephone (91.1% were reached) and asked several questions regarding their sun exposure and sun protection behaviors since their initial participation in the study (Figure). Participants provided oral informed consent at the time of telephone contact (consistent with the institutional review board policies at both institutions). Interviewers who conducted the follow-up were unaware of each participant’s group assignment.

To assess intentional sun exposure, participants were asked to estimate the number of hours they had sunbathed since their participation. Participants also were asked to estimate the average number of hours they had spent in the sun doing other activities on a typical weekday and weekend, respectively. These estimates were then averaged to form an incidental sun exposure index (r [130] = 0.58; P < .001). In addition, participants were asked whether they had used any sunscreen during the most recent time that they had sunbathed (yes, no) and the frequency with which they had used sunscreen on their face and body when sunbathing (0%-100%) since their participation. Participants were also asked these same 3 questions with regard to incidental sun exposure.

Separate 3-item indices of sunbathing protection (α = 0.77) and of incidental sun protection (α = 0.75) were subsequently created by first standardizing (via z scoring) and then averaging the relevant items. Next, participants were asked (yes, no) whether they had used the free sunscreen sample, whether they had given the sample away, and whether they had purchased any sunscreen since participation in the experiment. Responses to these 3 items were averaged to create an index of sample use and sunscreen purchase. Those who had been given a sunless Tanner sample were also asked how many times they had used the sample. Finally, participants were asked with how many family members or friends (if any) they had discussed information learned as a result of their participation. They were then fully debriefed.

STATISTICAL ANALYSIS

To determine the initial equivalence of the groups, 1-way analyses of variance were used to compare the intervention and control groups with respect to demographic characteristics and baseline sun exposure and sun protection variables. Any demographic or baseline variable found to differ across groups and to be significantly related to the outcome measures was controlled for in subsequent analyses.

Future sunscreen use intentions and all of the 1-month follow-up measures were analyzed using a set of planned orthogonal comparisons20 that involved comparing the 2 intervention groups with the control group and separately comparing the...
intervention-only group with the intervention plus sunless tanner group. We controlled for the respective levels of baseline sun exposure or sun protection in the analyses of the 1-month follow-up sun exposure and sun protection measures.

To minimize the number of tests and experimentwise error, the multiple measures of photoaging and sun protection perceptions were first analyzed using multivariate analyses of covariance followed by the separate planned comparisons for each measure.

## RESULTS

### DESCRIPTION OF SAMPLE AND BASELINE EQUIVALENCE OF GROUPS

Participants were primarily white and were a mean (SD) of 22.21 (4.66) years old (age range, 17-44 years). Twenty percent of participants reported sunbathing at least 1 hour during the previous weekend; 93.8% reported spending at least 1 hour in the sun doing something other than sunbathing during the previous weekend; and 96.6% spent at least 1 hour in the sun doing something other than sunbathing during the previous week. Fifty-six percent of participants reported knowing at least 1 person with skin cancer; 93.8% reported spending at least 1 hour in the sun doing something other than sunbathing during the previous weekend; 56% reported sunbathing at least 1 hour during the previous week; 93.8% reported spending at least 1 hour in the sun doing something other than sunbathing during the previous weekend; and 93.8% reported spending at least 1 hour in the sun doing something other than sunbathing during the previous weekend.

### INTENTIONS TO USE SUNSCREEN

Consistent with our expectations, analysis of the intentions scale indicated that participants in both intervention groups expressed significantly stronger intentions to use sunscreen regularly in the future than those in the control group (P<.001). As listed in Table 2, the mean value on the scale used to measure intention to use sunscreen was higher for participants in the intervention plus sunless tanner group than for those in the intervention only group, though this difference was not significant (P=.37).

### PHOTOAGING AND SUN PROTECTION PERCEPTIONS

Multivariate analysis of covariance results indicated that participants' overall perceptions of photoaging and sun protection were also altered by the intervention (P<.02). The univariate comparisons revealed that relative to controls, participants in the intervention groups reported significantly higher self-efficacy for regular sunscreen use (P<.03), higher perceived susceptibility to photoaging (P<.002), and higher perceived efficacy of sunscreen for prevention of photoaging (P<.004). In addition, participants in the intervention plus sunless tanner group expressed marginally higher self-efficacy for sunscreen use (P<.08) and significantly higher perceived susceptibility to photoaging (P<.01) than those in the intervention-only group.

### Table 1. Characteristics of 146 Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Finding*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>67.8</td>
</tr>
<tr>
<td>Asian</td>
<td>16.4</td>
</tr>
<tr>
<td>Hispanic</td>
<td>6.8</td>
</tr>
<tr>
<td>African American</td>
<td>2.1</td>
</tr>
<tr>
<td>Other</td>
<td>6.9</td>
</tr>
<tr>
<td>History of skin cancer</td>
<td>1.4</td>
</tr>
<tr>
<td>Family history of skin cancer</td>
<td>41.8</td>
</tr>
<tr>
<td>Skin type</td>
<td></td>
</tr>
<tr>
<td>Burns, never tans</td>
<td>7.6</td>
</tr>
<tr>
<td>Burns easily, then develops light tan</td>
<td>24.1</td>
</tr>
<tr>
<td>Burns moderately, then develops light tan</td>
<td>22.1</td>
</tr>
<tr>
<td>Burns minimally, then develops moderate tan</td>
<td>24.1</td>
</tr>
<tr>
<td>Does not burn, develops dark tan</td>
<td>15.9</td>
</tr>
<tr>
<td>Does not burn, naturally dark skin</td>
<td>6.2</td>
</tr>
<tr>
<td>No. of hours sunbathing last weekend, mean (SD)</td>
<td>0.65 (1.56)</td>
</tr>
<tr>
<td>No. of hours incidental sun exposure, mean (SD)</td>
<td>5.33 (4.35)</td>
</tr>
<tr>
<td>Frequency with which sunscreen used during sunbathing, % of time</td>
<td></td>
</tr>
<tr>
<td>On face</td>
<td>67.0</td>
</tr>
<tr>
<td>On body</td>
<td>50.9</td>
</tr>
<tr>
<td>Frequency with which sunscreen used during incidental exposure, % of time</td>
<td></td>
</tr>
<tr>
<td>On face</td>
<td>42.3</td>
</tr>
<tr>
<td>On body</td>
<td>21.6</td>
</tr>
</tbody>
</table>

*Unless otherwise noted, data are presented as percentage of participants.
The intervention also did not affect the amount of incidental sun exposure that individuals reported receiving during the subsequent month. However, the intervention significantly increased use of sun protection during incidental sun exposure. Specifically, analyses of the follow-up index of protective behavior during incidental exposure indicated that subjects in the intervention groups were more apt to use protection than were controls \((P<.02)\). Furthermore, the use of sunless tanner tended to further increase the level of protective behavior during the follow-up period relative to the intervention alone \((P<.08\); Table 2). Analyses of the sunscreen use index demonstrated that participants in both of the intervention groups tended to be more likely than controls to use the free sample of sunscreen and to purchase additional sunscreen \((P<.09)\). Again, those in the intervention plus sunless tanner group had the highest mean scores (Table 2), but these scores did not differ significantly from those in the intervention-only group \((P=.30)\).

Finally, 61% of the participants indicated that they had told at least 1 friend or family member about what they had learned from the study about UV damage and sun protection. As expected, analyses indicated that participants in the intervention groups (who had received photoaging information and viewed their UV photographs) talked to significantly more friends and family about what they had learned than did those in the control group \((P<.001\); Table 2). There were no differences between the 2 intervention groups.

Given escalating rates of skin cancer, it is important to develop effective risk-reduction interventions. Al-
though health-based interventions have had some limited success in reducing risky behaviors, such interventions generally ignore one of the primary motivators for skin cancer risk behaviors—immediate appearance enhancement. The present results add to the data suggesting that appearance-based interventions hold promise for motivating practices that will ultimately result in health benefits (ie, reduced skin cancer rates). Although there were no significant effects of the intervention on intentional or incidental sun exposure, there were significant changes in sun protection behavior (ie, sunscreen use). Specifically, individuals who received information about photoaging and were shown their UV facial photographs developed stronger intentions than controls to protect themselves from the sun, were more likely to report having used sun protection during subsequent incidental sun exposure, and were more likely to use the provided sunscreen sample and/or to purchase sunscreen.

These findings are consistent with the only previously published empirical investigation of the UV photographic intervention.15 However, in contrast to that study, the present participants had no idea that they would be contacted for follow-up, thus rendering implausible the notion that anticipation of reporting sun protection behaviors, rather than the intervention, was responsible for the increased sun protection behaviors.

Consistent with the findings of Mahler et al,15 participants who were shown their UV photographs shared the information learned about UV radiation effects and sun protection with more family members and friends than did controls. It is important to note that participants viewed their UV photographs for only a few minutes and were not allowed to take the photographs with them. It is conceivable that if individuals were given the photographs, the impact would be enhanced. That is, occasionally reviewing such a photograph might remind individuals of their accrued sun damage and help to maintain higher levels of motivation for engaging in sun protection. In addition, the photograph might become the focal point of sun protection discussions with friends and family and thereby have more far-reaching beneficial effects.

We also found that several perceptions regarding photoaging and sun protection were altered as a result of receiving the photoaging information and viewing the UV photograph. Specifically, those who received the intervention, relative to controls, came to view themselves as more susceptible to photoaging, became more convinced of the efficacy of sunscreen as a method of preventing photoaging, and developed greater confidence in their ability to use sunscreen regularly. The finding that such perceptions were altered by the intervention is important given that most models of health behavior (eg, Health Belief Model,33 Precaution Adoption Process,34 Protection Motivation Theory35) argue that it is the alteration of just such perceptions that is necessary to produce changes in health-risk behaviors. Thus, it is possible that the effect of the UV photographic intervention on sun protection intentions and behaviors was mediated by these perceptions. However, it is also worth noting that, consistent with the existing health-risk literature, the effects of the intervention on intentions and risk perceptions were more consistent than the effects on behavior. Changing intentions and risk perceptions is necessary, but not always sufficient, to produce behavior change.

Unfortunately, the effects of providing individuals with sunless tanning lotion as a safe alternative to UV exposure were not substantial. Although the mean values showed improvement for all 7 of the outcomes for which a difference was expected, the intervention plus sunless tanning lotion group differed from the intervention-only group on just 1 of those outcomes and then only marginally (greater use of sun protection during incidental exposure). The most likely explanation for these weak effects is the lower statistical power of the small sunless tanner group: it only included participants who had actually used the sample. During our telephone follow-ups we found that many individuals had a negative attitude toward sunless tanning lotion. For example, several individuals remarked that they would never use sunless tanning lotion because, among other reasons, they had heard that it does not look natural, it would turn their skin orange, and it would leave a “streaked” appearance. Because only 37% of the participants tried the sunless tanning lotion sample, most did not have the chance to develop positive attitudes toward it as an alternative method of obtaining a tan. It may be necessary to debunk the myths of sunless tanning lotion or to develop methods of inducing participants to try it to foster the development of positive attitudes toward this alternative.

This experiment has several methodologic strengths. A novel technique for reducing skin cancer risk was evaluated with a population that is prone to high rates of incidental sun exposure (Southern California college students). Baseline sun exposure and sun protection behaviors, along with relevant demographic characteristics, were assessed and statistically controlled in the analyses, when appropriate. The experiment included the assessment of several health-risk and health-behavior perceptions that have been linked with varying degrees of success to achieving risk modification in other health domains. Finally, and perhaps most importantly, this experiment went beyond immediate behavioral intentions by assessing reported sun exposure and protection behaviors during the month following the intervention in a “surprise” telephone follow-up.

However, it is important to note that the experiment involved a relatively small sample size (particularly with respect to the subgroup that received the intervention and used the sunless tanning lotion sample), thus limiting statistical power. Also, the follow-up period was only 1 month, thus precluding determination of the longer-term effects of the intervention. In addition, because all findings are based on self-reports, it is not possible to rule out response bias. However, it should be noted that previous work has demonstrated significant associations between self-reported and actual sun protection behavior,9,36-38 and all participants were sensitized to the issues being investigated. That is, even participants in the control group completed all of the measures and were debriefed regarding the general purpose of the study after the initial session in the laboratory. If the findings were due simply to demand, one would expect across-the-
board differences between the intervention and control groups rather than the pattern observed. Nonetheless, it would be desirable for future work to use more objective behavioral measures of sun exposure (e.g., a spectrophotometer). One difficulty of a spectrophotometer in the present context, however, is that it cannot distinguish skin color that is the result of UV exposure vs sunless tanning lotion. Finally, participants were all Southern California college students, potentially limiting generalizability to other populations or to other regions of the country.

Ultraviolet-filtered photography is used both commercially and by many practicing dermatologists. However, to date there has been only 1 published empirical study examining its effect on behavior. The present results, in concert with the findings of Mahler et al, indicate that this intervention can significantly impact self-reported behaviors. Assuming that future work confirms the efficacy of the intervention using more objective indicators of behavior, this appearance-based intervention can have important practical applications. Ultraviolet instant cameras are readily available, relatively inexpensive, and simple to operate. In fact, with the model used in this experiment, individuals could easily take their own photographs (alleviating the need to assign staff time to take photographs). Thus, it seems plausible that this intervention could be offered at most dermatology offices, student health clinics, and physicians' offices.

In addition, it is likely that the endorsement by a physician or nurse of sunless tanning lotion as a safe and effective alternative to UV exposure would induce more individuals to try it. Based on the trends observed in this experiment with the small percentage of participants who tried the sunless tanning lotion, this might lead to additional sun protection behaviors. Of course, it would be important for clinicians to encourage the regular use of sunscreen and to explain that a tan achieved with sunless tanning lotion does not provide sun protection.

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