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Do ultraviolet photos increase sun safe behavior expectations via fear? A randomized controlled trial in a sample of U.S. adults

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Abstract Ultraviolet (UV) photos reveal the world in a different light spectrum, including damage that is caused by UV light. In the context of skin cancer control, UV photos have the potential to communicate fear because they reveal underlying skin damage. U.S. adults ($N = 2219$) were assigned to a 5 (visual: UV skin damage, sun exposure, sunburn, photoaging, and mole removal) × 3 (replication: three examples of each visual condition) × 4 (efficacy: no efficacy, text only, visual, visual + text) randomized controlled trial. Compared to all other visual conditions combined, UV skin damage visuals generated greater fear which triggered increased sun safe behavior expectations. Compared with other visual conditions separately, only mole removal visuals produced equivalent fear as UV skin damage visuals. Visual efficacy conditions appeared to nullify rather than magnify the indirect path through fear. The results suggest one way UV images impact sun safe behavioral expectations is via fear and that researchers should continue to examine the position of fear in fear appeal theories.

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Visuals are often used to communicate skin cancer risk because aspects of the risk, and the cancer, are visible (i.e., moles, mole removal scars) or appearance based (i.e., tanning behavior). This explains the abundance of visual images in skin cancer prevention campaigns and social media as well as the pursuit of innovative approaches to visualizing skin cancer risk. Concerning the latter, ultraviolet (UV) photos (i.e., photographs taken using UV light) reveal skin damage as dark spots and patches, which are caused by the agglomeration of melanin just beneath the skin's surface. These UV photos can be used to assess and communicate melanoma risk (Gamble et al., 2012; Hornung & Strecher, 2012). Accordingly, researchers have utilized UV photos in skin cancer prevention interventions. A meta-analysis found that UV photo interventions increased sun safe behavior and perceived susceptibility to aging of the skin (also known as photoaging; Williams et al., 2013). The meta-analysis did not examine fear, as no available study had assessed it in an experimental design.

UV photos could be conceptualized as fear appeals, as they can cause viewers to reflect on the sun damage present in their own skin. Researchers have devoted considerable resources to studying fear appeals, or attempts to influence behavior by providing frightening information (Shen & Coles, 2015; Witte, 1992b, 1994; Witte & Allen, 2000). In pursuit of this goal, researchers have developed and refined numerous fear appeal theories over the past 50 years (Tannenbaum et al., 2015). The extended parallel process model (EPPM) represents a synthesis of earlier fear appeal theories, and has become one of the cornerstone frameworks for the study of fear (Maloney et al., 2011). Different

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message types have been evaluated using the EPPM, including texts (Krieger & Sarge, 2013), visuals (Jain et al., 2017), audio (Birmingham et al., 2015), and audiovisuals (Shi & Smith, 2016). Of these, scholars have noted a need for more research exploring visual fear appeals (King, 2015a).

The current study contributes to research on UV photo interventions, the EPPM, and visual fear appeals by comparing the persuasive impact of UV photos of skin damage to other visuals that convey skin cancer risk, tests a UV efficacy visual (e.g., a person putting on sunscreen in UV light), and tests fear as a mediator. In a larger sense, the study compares five different types of skin cancer visuals (UV skin damage visuals, visuals of people engaging in sun exposure, visuals showing sunburned skin, visuals depicting aged skin, and mole removal incision visuals) and thus provides a foundation for future research focused on visual communication and skin cancer prevention.

The EPPM: A framework for studying fear appeals

The EPPM postulates that threat, efficacy, and fear all play a role in the processing of fear appeals (Witte, 1994). In the EPPM, threat is comprised of severity and susceptibility, where severity is the perceived *magnitude* of the negative consequences related to a hazard, and susceptibility is the perception of *self-vulnerability* to a hazard (Witte, 1994). Efficacy beliefs are comprised of self-efficacy and response efficacy, where self-efficacy is the perception of one's own *ability to perform* recommended behaviors, and response efficacy is the belief in the *effectiveness* of those behaviors in reducing or preventing a threat (Witte, 1994). But the EPPM is ultimately a framework for studying fear appeals and, fittingly, fear is central to the model. Within the EPPM, fear is defined as "… an internal emotional reaction comprising psychological and physiological dimensions that may be aroused when a serious and personally relevant threat is perceived,'' (Witte et al., 1996, p. 320). Fear is generated by demonstrating the negative consequences of a particular behavior in an at-risk individual; for example, a common smoking cessation fear appeal is to show imagery of a smoker's tar coated lung as compared to a non-smoker's healthy lung.

The EPPM postulates that the interaction of perceived threat and efficacy will ignite a fear response; if threat is sufficiently mitigated by the efficacy portion of the message, it activates a danger control process that leads to the adoption or acceptance of the behaviors promoted by the intervention (Witte, 1992a, b; Witte et al., 1996). However, threat unmitigated by efficacy activates a fear control process that generates uncontrolled fear which ultimately leads to rejection of the message. A review article summarizing six meta-analyses concluded that self-efficacy, response efficacy, and susceptibility are critical in achieving the intended results of fear appeals, whereas emphasizing the severity of a threat was not as impactful (Ruiter et al., 2014).

The EPPM is an important theory that has aided in the growth of fear appeal research (Maloney et al., 2011), but additional evaluation and exploration of the theoretical framework can strengthen it even further. To that end, researchers have pointed out a need for more experimental research evaluating fear-appeal theories (Peters et al., 2013). Notably, debate continues on the mediating role of fear within fear appeal theories (O'Keefe, 2003; Popova, 2012). In their meta-analysis of fear appeal research, Tannenbaum et al. (2015) specifically note the lack of studies directly testing fear as a mediator:

> Although many fear appeal theories discuss fear, empirical studies typically test the impact of fear appeal messages on outcomes, and subsequently infer that message effects were mediated by experienced fear even though fear itself is rarely measured (for a discussion, see Popova, 2012, p. 466). Indeed, only 71 of the 248 studies in the current meta-analysis measured fear directly, and such measures were typically treated as manipulation checks rather than independent variables or mediators. (p. 1180)

Thus, there is a need for more theoretically grounded research that directly assesses fear as a mediator (not a manipulation check) to determine how it functions in fear appeal research (O'Keefe, 2003; Popova, 2012; Tannenbaum et al., 2015).

Skin cancer prevention, ultra-violet (UV) photo interventions, and the EPPM

Skin cancer prevention is a suitable context for evaluating the EPPM as there is a heavy reliance on fear-based messaging and visuals (see, e.g., Mays & Zhao, 2016). Skin cancer is the most common type of cancer in the United States (Siegel et al., 2018), and efforts to educate the public about both risks and preventative behaviors rely heavily on visual messages, with significant variance in the forms, features, and categories used in these efforts (King, 2015b). Use of visual messages in skin cancer prevention efforts is common because unlike most types of cancer, skin cancer lesions are outwardly visible. These visual messages often include fear appeal elements, such as showing the results of blistering sunburns or the removal of cancerous lesions. However, it is inherently difficult to visualize the underlying cumulative skin damage as a result of excessive sun exposure, tanning, and blistering sunburns. Most skin damage is long-term and cumulative. The inability to see skin damage in visible light might explain the attraction of tanning. Tanners may value short-term gains in appearance while disregarding the invisible damage to the skin that leads to long-term damage and risk.

UV photography offers an innovative solution to the challenge of visualizing skin damage. UV photographs are capable of revealing existing skin damage caused by UV light exposure which is normally invisible to the naked eye. Gamble et al. (2012) linked the damage depicted in UV photographs with phenotypic risk of developing melanoma (the most dangerous type of skin cancer), suggesting that UV photographs can help identify high-risk individuals. Since then, UV photography interventions have shown significant results in diverse samples, including children aged 11–13 (Demierre et al., 2009) and teenagers (Taylor et al., 2016). Moreover, a meta-analysis found that UV photo interventions have positive impacts on sun-safe behavior and susceptibility to photoaging (Williams et al., 2013).

UV photos increase perceived susceptibility to photoaging, but do they increase perceived susceptibility to skin cancer and/or fear? One past study found that UV photo interventions increase perceived susceptibility to skin cancer (Emmons et al., 2011; for a review, see McWhirter & Hoffman-Goetz, 2015). Scholars have highlighted the importance of affect—particularly negative emotions—for interventions promoting sun-safe behaviors through appearance-based interventions (Mahler, 2014, 2015, 2018). Two studies (Mahler, 2014; 2018) have assessed negative affect following exposure to UV photos, but only Mahler (2018) included a non-UV photo comparison condition. The evidence in hand suggests that UV photos likely generate negative affect compared to non-UV conditions. However, further investigation to parse out the affective component produced by UV photos is needed. Thus, we evaluate these queries and basic postulates of the EPPM in the first set of hypotheses:

H1 Compared to all other visual categories combined, a UV skin damage visual condition will generate greater (a) susceptibility, (b) severity, and (c) fear.

UV photos could also target self-efficacy and response efficacy by depicting an individual putting on sunscreen (which appears black in UV light). Utilizing this approach, we included four types of efficacy messages within the current study. Participants received either a no efficacy message, a text-only efficacy message, a UV visual only message (depicting an individual putting on sunscreen in UV light), or a combined visual and text message. We hypothesize that:

H2 Compared to the no efficacy and text-only efficacy message conditions, efficacy messages including a UV efficacy visual will generate greater (a) self-efficacy and (b) response efficacy.

The existing findings of UV intervention studies (Emmons et al., 2011; Mahler, 2014, 2015, 2018) mirror larger questions within fear appeal literature as past EPPM research has also questioned whether perceived threat triggers fear (or vice versa), whether fear needs to have a more prominent position in the model, and the ideal positioning and role of fear within the EPPM (Dillard et al., 2016a; b; So, 2013; Witte, 2013). Indeed, a recent meta-analysis noted that past research has rarely tested the mediational role of fear (Tannenbaum et al., 2015). To this end, Mahler (2018) demonstrated that exposure to a UV photo and comparison photos of peers (with lower skin damage than themselves) generated negative emotions, which then mediated the relationship between condition and sun protection intentions.

Skin damage manifests over time, and so do sun safe behaviors. This presents skin cancer researchers with a challenge as quantifying sun safe behavior requires a measure of achieved or intended action across time. Recently, Armitage et al. (2015) found that behavioral expectation—what a person expects to do—is a better predictor of actual behavior than behavioral intention. Given that, the current study created measures of sun safety expectations to serve as an outcome to assess the emerging questions generated in EPPM literature. The following hypotheses postulate the mediating role of fear and moderating role of efficacy stimuli:

H3 Fear will mediate the relationship between exposure to UV skin damage visuals and sun safety behavioral expectations, such that participants in the UV skin damage visual condition will report greater fear, which will be positively related to behavior expectations regarding sun-safe practices.

H4 Exposure to a UV efficacy visual will moderate the indirect path through fear, such that the indirect effect of UV skin damage visuals on sun safety behavior expectations is larger for individuals receiving the efficacy visual.

Several studies of UV photo interventions have shown that UV photos promote skin cancer prevention behaviors (Gibbons et al., 2005; Mahler et al., 2003, 2007; Walsh et al., 2014; Walsh & Stock, 2012). These previous studies were based on personalized UV photos (i.e., photos of the person in question), but the effects of stock UV photos (i.e., photos of unknown individuals) would benefit from additional research. The value of stock UV photos is that they are easy to generate/acquire and more comparable to most existing skin cancer visuals (which are typically stock images). Understanding the impact of stock UV photos also helps researchers to better understand the impact and value of personalized UV photos by isolating one message feature (UV) from another (personalized). Thus, the current study compares stock UV skin damage photos with four alternative forms of skin cancer risk visuals (visuals depicting sun exposure, sunburn, photoaging, or mole removal). In addition to examining how UV skin damage visuals perform compared to naturally-occurring skin cancer risk visuals in general, it is also valuable to study how UV skin damage visuals perform when compared with each of these discrete, naturally-occurring categories. For example, past research has found that visuals depicting the aftermath of mole removal can generate significant fear (Mays & Zhao, 2016). To understand the relative persuasive effects of stock UV visuals in comparison with other naturally-occurring skin cancer risk visuals, we asked the following research question (RQ):

RQ1 Compared to the UV skin damage visual category, is there another naturally-occurring skin cancer risk visual type that yields equivalent or greater impact on (a) susceptibility (b) severity, (c) self-efficacy, (d) response efficacy, (f) fear, and (e) behavioral expectation.

Method

Participants and procedure

Qualtrics Panels recruited 2219 adults (age range 18–89, M_{age} = 43.49, SD = 15.82) from their national panel into an online message experiment. Approximately 45% of the participants were male. The participants filled out a consent form, completed a pretest, viewed one of the experimental conditions, and completed a posttest. The pretest survey included questions about demographics, susceptibility, severity, self-efficacy, response-efficacy, and behavior expectation. The post-test measured fear, susceptibility, severity, self-efficacy, response-efficacy, and behavior expectation. Participants were offered a small financial incentive by Qualtrics Panels to participate in the study.

Study design

Participants were randomized to one of sixty conditions in a 5 (Visual factor: UV skin damage visuals, sun exposure visuals, sunburn visuals, photoaging visuals, and mole removal visuals) × 3 (replication factor: three examples of each visual condition) × 4 (Efficacy factor: no efficacy, text only, visual only, text + visual) between-participants message experiment. The replication factor was nested within the visual factor.

Stimuli

Stock UV skin damage photos were produced in our lab using a VISIA UV camera system. Members of the research team posed for UV skin damage photos. All comparison group visuals were collected from the educational materials, websites, blogs, and social media pages (Facebook and Instagram) of organizations such as the Skin Cancer Foundation, the American Academy of Dermatology, the Centers for Disease Control and Prevention (CDC), and the American Cancer Society. Our research team found that the educational materials and social media pages designed by governmental and non-governmental organizations generally used four different types of visuals: visuals focusing on sun exposure, including sun bathing with or without sun protective items (i.e., hats, sunglasses, umbrella); visuals showing sunburns, including a body part or face that is severely burnt; visuals that deliver information about photoaging, such as an image showing a single individual with both photo-aged and non-aged skin; and visuals of cancerous mole removals, including both cancerous moles and surgical excisions. Refer to "Appendix 1, 2, 3, 4, 5" for all the visual condition stimuli.

The efficacy condition had four levels: control (no efficacy stimuli), text-only efficacy stimuli, UV visual-only efficacy stimuli, and UV visual + text stimuli. The text stimuli discussed different behaviors that a person can do to prevent skin cancer, and the visual stimuli depicted a person's face under both natural light and UV light. Half of the person's face is covered with sunscreen, which is invisible in the natural light photo but appears black in UV photo. The latter demonstrates the potential for sunscreen to block UV rays from the sun, and prevent them from reaching the skin. Thus, the image has the potential to impact self-efficacy (the individual is depicted putting on sunscreen) and response efficacy (the sunscreen is effective at blocking UV). Efficacy stimuli are included in "Appendix 6 and 7".

Measures

Demographics

In the pretest, participants provided demographic information, including age, sex, ethnicity, household income, highest level of education, and marital status. Skin cancer related risk was measured using a brief risk assessment tool (BRAT; Glanz et al., 2003).

Behavior expectations

Baseline and posttest sun safety behavior expectations were measured on a seven-point scale ranging from 1 (*extremely unlikely*) to 7 (*extremely likely*) (Pretest: $\alpha = .85$, $M = 4.86$, $SD = 1.48$; Posttest: $\alpha = .88$, $M = 5.23$, $SD = 1.45$). We measured behavior expectations as opposed to behavior intention based on research by Armitage et al. (2015), which demonstrated that what a person expects to do is a better predictor of actual behavior than what a person intends to do. The only difference between behavior expectation and behavior intention is that while measuring the former, participants are asked how likely they are to use various sun safety behaviors as opposed to whether they intend to use those behaviors. The measures were reworded from behavioral measures of photo protection, which were previously developed and validated (Aspinwall et al., 2014). The items ask how likely the individuals were to perform these behaviors in the future—"using sunscreen," "reapply sunscreen after swimming or perspiration," "wearing protective clothing (long pants and sleeves)," "avoiding peak UVR exposure from 10 AM to 4 PM," and "stayed in the shade." We added two additional items to the scale: "wearing broad brimmed hat," and "wearing sunglasses."

Self-efficacy

Self-efficacy related to sun safe behavior was assessed with nine-items measured on a seven-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) (Pretest $\alpha = .90$, $M = 4.90$, $SD = 1.28$; Posttest $\alpha = .93$, $M = 5.15$, $SD = 1.34$). The individual items are modified from two previously used scales. Six of the items were used from Witte (2000): "I am able to use sunscreen with at least SPF-15 or higher to prevent skin cancer," "Using sunscreen with at least SPF-15 or higher to prevent skin cancer is easy for me," "Reapplying sunscreen every 2 h to prevent skin cancer is convenient for me," "Reapplying sunscreen after swimming or perspiring to prevent skin cancer is easy for me," "Wearing a hat that provides shade for my face to prevent skin cancer is easy for me," and "I am able to minimize my exposure to the sun at midday to prevent skin cancer." The three remaining items were from a different scale (Heckman et al., 2017): "use sunscreen when I am out in the warm sun for more than 15 min," "use sunscreen when none of my friends are using it," and "use sunscreen even if I don't like how it feels."

Response efficacy

Response efficacy was assessed using eight-items measured on a seven-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) (Pretest $\alpha = .97$, $M = 5.29$, $SD = 1.33$; Posttest $\alpha = .97$, $M = 5.47$, $SD = 1.39$). The individual items were statements such as "My using sunscreen is effective in preventing skin cancer," "Applying sunscreen with at least a SPF-15 or higher is effective in preventing skin cancer," "Applying sunscreen to all areas of my body exposed to the sun is effective in preventing skin cancer," and "Reapplying sunscreen every 2 h is effective in preventing skin cancer." These items are modified from Witte (2000).

Susceptibility

Susceptibility was measured using three-items and a seven-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) (Pretest $\alpha = .92$, $M = 4.41$, $SD = 1.58$; Posttest $\alpha = .94$, $M = 4.61$, $SD = 1.59$). These items were developed by Witte et al. (1996); "I am likely to get skin cancer sometime during my life," "I am at risk of getting skin cancer sometime during my life," and "It is possible that I will get skin cancer sometime during my life."

Severity

Severity was also measured by the items developed by Witte et al. (1996). These items are "I believe that skin cancer is a severe health problem," "I believe that skin cancer is a serious threat to my health," and "I believe that skin cancer is a significant disease." These items were measured in a seven-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) (Pretest $\alpha = .86$, $M = 5.42$, SD = 1.32; Posttest $\alpha = .9$, $M = 5.52$, $SD = 1.38$).

Fear

A six-item scale developed by Witte (2000) was used to measure perceived fear produced by the study stimuli. The six items are assessed by a seven-point scale ranging from 1 (*not at all*) to 7 (*very much*) ($\alpha = .96$, $M = 2.77$, $SD = 1.75$) that asks participants to answer how much the message made them feel—"frightened," "tense," "nervous," "anxious," "uncomfortable," and "nauseous."

Randomization check

We first ran a three-way MANOVA to check whether visual conditions (UV skin damage, sunburn, sun exposure, aging, and mole removal), efficacy conditions (no efficacy, text only, visual only, and text + visual) and the interaction of the two were related to demographic variables (age, education, income) and the BRAT index. The multivariate tests were not significant for visual condition, Pillai's Trace = .01, $F(16, 8760) = .72$, $p = .78$, efficacy conditions, Pillai's Trace = .01, $F(12, 6567) = .87$, $p = .58$, or the visual condition × efficacy condition, Pillai's Trace =

.02, $F(48, 8760) = 1.10$, $p = .30$. This supports that the demographic variables and BRAT index were successfully randomized across experimental conditions.

Next, a 5 (visual conditions) × 3 (replications) × 4 (efficacy conditions) MANOVA with replications as a nested factor examined randomization for all of the EPPM test variables (except for perceived fear) and sun safe behavior expectations. Fear was only measured in the post-test because it is a state-based measure (i.e., capturing the impact of exposure to the stimuli). The pre-test measures helped us identify if any of the main variables (mediators and outcome variables) were significantly related to any of the experimental conditions (i.e., failure of randomization). The multivariate test was not significant for visual condition, Pillai's Trace = .01, $F(24, 8752) = 1.24$, $p = .20$, efficacy condition, Pillai's Trace = .01, $F(18, 6561) = .76$, $p = .75$, or the visual condition × efficacy condition, Pillai's Trace = .03, $F(72, 13{,}140) = .97$, $p = .55$.

Results from these two MANOVAs demonstrate that randomization was successful for the study. Thus, we did not use any of the pretest variables and demographics in the analyses for the hypothesis testing. It is important to note that the basic results of the study do not change if the pre-test variables are included as controls.

Power analysis

G * Power was used to identify the optimum sample size for the study a priori (Erdfelder et al., 1996). G * Power estimated that a sample size of 1788 was required to detect a small effect size of .10 with power of .95. Our final sample size was 2219.

Results

Bivariate correlations

Bivariate correlations were calculated to examine zero order relationships between all variables (see Table 1). As expected, there were significant positive correlations among the central constructs of the EPPM. Sun safe behavioral expectation was positively correlated with susceptibility ($r = .34$, $p < .001$), severity ($r = .57$, $p < .001$), self-efficacy ($r = .72$, $p < .001$), and response efficacy ($r = .61$, $p < .001$). A contrast variable was created comparing the UV skin damage visual (1) to all other visual conditions combined (0) (labeled, UV vs. All). UV vs. All was positively correlated with fear ($r = .09$, $p < .001$) and fear was also positively correlated with behavior expectation ($r = .22$, $p < .001$).

UV versus All (H1 and H2)

The first set of hypotheses postulated that a UV skin damage visual would generate greater (a) susceptibility, (b) severity, and (c) fear compared to all other visual categories combined (i.e., UV vs. All). Analysis of variance (ANOVA) was utilized to test this hypothesis. Compared to all other conditions combined, the UV skin damage visual did not generate greater susceptibility, $F(1, 2199) = .06$, $p = .81$, or severity, $F(1, 2199) = .32$, $p = .57$. However, UVvsAll generated greater fear, $F(1, 2199) = 16.68$, $p < .001$. A pairwise comparison showed that the UV skin damage condition produced significantly greater fear ($M = 3.07$, $SE = .08$) than all other visuals combined ($M = 2.69$, $SE = .04$, $p < .001$, Cohen's $d = .27$), supporting H1c (means and standard errors are provided in Table 2).

The second set of hypotheses postulated that a UV efficacy visual condition would increase (a) self-efficacy and (b) response efficacy, when compared to a control or text-only efficacy condition (see Table 2). ANOVA analysis demonstrated that the efficacy conditions did not differ for response efficacy, $F(3, 2199) = .67$, $p = .57$, but there was a marginally significant difference for self-efficacy, $F(3, 2199) = 2.41$, $p = .07$. Pairwise comparisons revealed that the UV efficacy visuals increased self-efficacy ($M = 5.31$, $SE = .06$) compared to the control efficacy condition ($M = 5.06$, $SE = .06$, $p < .01$, Cohen's $d = .11$), text-only efficacy condition ($M = 5.12$, $SE = .06$, $p = .02$, Cohen's $d = .08$), and UV efficacy visual + text condition ($M = 5.12$, $SE = .06$, $p = .02$, Cohen's $d = .08$). There were no significant differences within types of efficacy condition for response efficacy. Thus, there was support for H2a, but not support for H2b.

Fear as a mediator (H3)

Our third hypothesis stated that fear would mediate the relationship between exposure to the UV skin damage visual and behavioral expectations such that those in the UV condition would report greater fear which would increase behavior expectations. Simple mediation analysis (PROCESS Model 4, see Hayes, 2013) was used to test this hypothesis. Consistent with H3, simple mediation analysis revealed that fear significantly mediated the relationship between exposure to UV skin damage visuals and behavioral expectation, effect = .07, Boot $SE = .02$, 95% Boot CI: .0373, .1086, effect size k^2 (kappa-squared) = .02 (see Table 3). The UV skin damage visual condition generated greater fear (coefficient = .38, $SE = .09$, $t = 4.06$, $p < .001$), which then significantly triggered sun safe behavior expectation (coefficient = .18, $SE = .02$, $t = 10.72$, $p < .001$). The simple mediation models are presented in Fig. 1.

Table 1 Bivariate correlations

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	13
1. Susceptibility	–												
2. Severity	.54***	–											
3. Self-efficacy	.42***	.66***	–										
4. Response efficacy	.46***	.72***	.79***	–									
5. Fear	.28***	.18***	.20***	.15***	–								
6. Behavior expectation	.34***	.57***	.72***	.61***	.22***	–							
7. UV vs. All	.01	.01	–.01	.00	.09***	.00	–						
8. Age	.04*	.12***	.14***	.16***	–.07***	.07**	.01	–					
9. Sex	.01	.09***	.09***	.10***	–.08***	.08***	.03	–.08***	–				
10. Education	.13***	.09***	.13***	.13***	.09***	.10***	–.03†	.02	–.06**	–			
11. Income	.16***	.13***	.19***	.19***	.15***	.14***	–.01	.03	.00	.44***	–		
12. White	.23***	.12***	.12***	.14***	–.01	.07***	–.01	.19***	.03	.06**	.15***	–	
13. Hispanic	–.04†	–.02	.00	–.04†	.04†	.04†	–.01	–.21***	–.03	–.02	–.02	–.17***	–
14. BRAT index	.37***	.18***	.17***	.17***	.18***	.16***	.03	.04†	.00	.13***	.16***	.36***	–.03

UV vs. All is the UV skin damage visual condition compared with all other visual conditions combined (UV skin damage = 1, all other conditions combined = 0)

†$p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

Table 2 Means and standard errors for mediators and outcomes by visual and efficacy condition

		Susceptibility	Severity	Self-efficacy	Response efficacy	Fear	Behavior expectation
UV versus All	UV	4.62 (.08)	5.55 (.07)	5.12 (.06)	5.47 (.07)	3.07 (.08)[a]	5.21 (.07)
	Other conditions combined	4.60 (.04)	5.51 (.03)	5.16 (.03)	5.47 (.03)	2.69 (.04)[b]	5.23 (.03)
Mole versus All	Mole	4.64 (.08)	5.56 (.07)	5.23 (.06)	5.58 (.07)	3.03 (.08)[a]	5.31 (.07)
	Other conditions combined	4.60 (.04)	5.51 (.03)	5.13 (.03)	5.45 (.03)	2.71 (.04)[b]	5.21 (.03)
Efficacy conditions	No efficacy	4.62 (.07)	5.51 (.06)[ab]	5.06 (.06)[a]	5.41 (.06)	2.73 (.07)	5.14 (.06)[a]
	Text	4.60 (.07)	5.51 (.06)[ab]	5.12 (.06)[a]	5.50 (.06)	2.80 (.07)	5.17 (.06)[a]
	Visual	4.64 (.07)	5.61 (.06)[a]	5.31 (.06)[b]	5.55 (.06)	2.76 (.07)	5.35 (.06)[b]
	Visual + text	4.57 (.07)	5.44 (.06)[b]	5.12 (.06)[a]	5.44 (.06)	2.78 (.07)	5.25 (.06)[ab]

Means and standard errors (in parentheses)

Means with different superscripts are significantly different, $p < .05$

UV efficacy as a moderator (H4)

Moderated mediation analysis (PROCESS Model 8, see Hayes, 2013) was used to test H4, which postulated that the UV efficacy visual would moderate the indirect path through fear such that the indirect effect of UV skin damage visuals on sun safe behavior expectations would be larger for individuals receiving the visual efficacy. Moderated mediation analysis revealed that the UV efficacy visual condition significantly moderated the indirect path through fear (see Fig. 2). However, contrary to H4, the indirect effect was significant in the control (explaining 4% of the variance in behavior expectations) and text-only (explaining 3%) conditions. In those conditions, the UV threat condition increased fear which increased behavior expectations.

Readers might question whether this finding is an artifact of the non-UV condition containing UV imagery in the visual and visual + text efficacy conditions (i.e., the UV efficacy visual). If this explanation was valid, then fear would increase in the non-UV conditions when the UV efficacy visual was present. The data does not support this explanation as fear did not increase in the non-UV conditions when the UV efficacy visual was present (see "Appendix 9"). Instead, fear decreased in the UV threat condition when the UV efficacy image was present.

Table 3 Simple mediation—tests of indirect effects of EPPM variables

N = 2220	Models without mediator		Models with mediator									
	B		B					Bootstrap results for indirect effects (95% CI)		Bootstrap results for indirect effect sizes (95% CI)		
	R^2	c	R^2	c′	a	b	ab	Lower	Upper	k^2	Lower	Upper
Susceptibility	.00	− .02	.12***	− .02	.02	.31***	.01	− .0473	.0582	.01	.0000	.0065
Severity	.00	− .02	.33***	− .04	.04	.60***	.03	− .0621	.1153	.01	.0001	.0288
Self-Efficacy	.00	− .02	.52***	.02	− .04	.78***	− .03	− .1392	.0790	.01	.0001	.0399
Response Efficacy	.00	− .02	.37***	− .01	− .01	.64***	− .01	− .0995	.0947	.00	.0000	.0026
Fear	.00	− .02	.05***	-.09	.38***	.18***	.07*	.0373	.1086	.02	.0105	.0305

Process Model 4 with 1000 bootstraps where each mediators was tested one at a time. Fear is the only significant mediator as the boot confidence interval does not overlap zero. Predictor is UVvsAll contrast, outcome is behavior expectation

B unstandardized regression weights, *c* total effect of predictor on outcome without the mediator in the model, *c′* direct effect of predictor on outcome while controlling for the mediator, *a* the path between the predictor and the mediator, *b* the path between the mediator and the outcome, *ab* indirect effect of predictor on outcome thorough the mediator, R^2 amount of variance explained by the model, *CI* confidence intervals, k^2 effect size

*$p <$ .05; ***$p <$ .001

Comparison of UV to other naturally occurring visual categories (RQ1)

RQ1 queried if there was another naturally occurring skin cancer risk visual type that yields equivalent or greater impact on (a) susceptibility (b) severity, (c) self-efficacy, (d) response efficacy, (e) fear, and (f) behavior expectations. A series of 5 (visual conditions) × 3 (replications) × 4 (efficacy conditions) between-participant ANOVAs were conducted with replications as a nested factor.

Visual condition was significantly related to self-efficacy, $F(4, 2190) = 3.06$, $p = .02$, and fear, $F(4, 2190) = 12.20$, $p < .001$. For self-efficacy, sunburn visuals ($M = 4.97$, $SE = .06$) were significantly different than sun exposure visuals ($M = 5.20$, $SE = .06$, $p < .01$, Cohen's $d = .18$), aging visuals ($M = 5.23$, $SE = .06$, $p < .01$, Cohen's $d = .21$), and mole removal visuals ($M = 5.23$, $SE = .06$, $p < .01$, Cohen's $d = .21$). None of the visuals were significantly different in producing self-efficacy compared to UV skin damage visual. For fear, the UV skin damage visual generated significantly greater fear ($M = 3.07$, $SE = .08$) when compared with the sunburn visual ($M = 2.61$, $SE = .08$, $p < .001$, Cohen's $d = .27$), sun exposure visual ($M = 2.39$, $SE = .08$, $p < .001$, Cohen's $d = .40$), and aging visual ($M = 2.76$, $SE = .08$, $p < .01$, Cohen's $d = .18$), but not with the mole removal visual ($M = 3.03$, $SE = .08$, $p = .72$, Cohen's $d = .02$). Thus, only the mole removal visuals produced equivalent fear as the UV sun damage visuals (see Table 4). Given this finding, readers might be interested to know how mole removal images compare to other images in general. Results of ANOVAs with the contrast MolevsAll are presented in Table 2 and the simple mediation with fear and other EPPM variables are presented in "Appendix 11". When compared with all other visual conditions combined, mole removal visuals produce greater fear, and fear mediates the relationship between condition and behavior expectations. Thus, MolevsAll yields the same pattern of results as UVvsAll.

There was no significant interaction between visual and efficacy conditions on any of the dependent variables. Means, standard errors, and confidence intervals for interactions are presented in "Appendix 8". Some readers might be interested in an analysis that examines visual condition as a five-level categorical predictor. An output for simple mediation analyses with all 5 visual condition as a categorical predictor, fear as mediator, and behavior expectations as outcome is included in "Appendix 12".

Discussion

Our results demonstrate that stock UV skin damage visuals elicit fear, which in turn triggers positive sun-safe behavior expectations. Thus, it appears that stock UV skin damage visuals are best categorized as fear appeals. Mole removal visuals demonstrated a similar pattern (increased fear and fear as a mediator).

UV skin damage visuals triggered fear, but did not increase threat susceptibility, which raises questions about the relationship of fear and susceptibility. In past studies, personalized UV photos have increased perceived susceptibility (Emmons et al., 2011; see McWhirter & Hoffman-Goetz, 2015). Generally, and perhaps somewhat surprisingly, fear appeal research has not examined the relation-

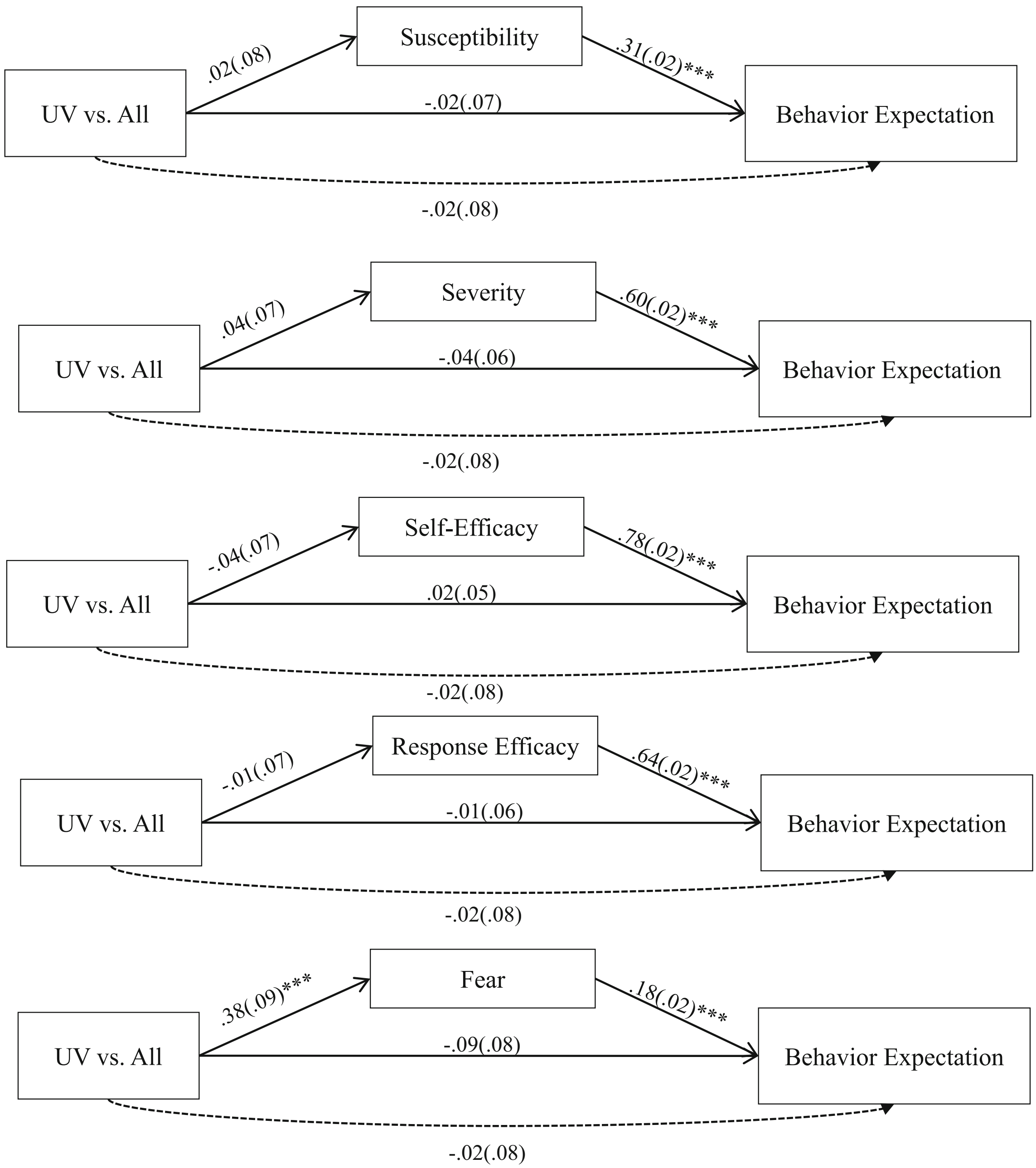

Fig. 1 Simple mediation model of the EPPM. Only fear significantly mediated the relation between X (UV vs. All) and Y (Behavior Expectation): effect = .07, Boot *SE* = .02, 95% Boot *CI*: .0373, .1086, effect size (k^2) = .02. ***$p < .001$

ship between fear and susceptibility (Tannenbaum et al., 2015). The research community would benefit from more fear appeal studies that examine the relationship between these two variables, and that test both as potential mediators. Researchers should also carefully consider how both constructs are measured. Indeed, studying and refining key constructs in fear appeal research is a crucial next step. The use of physiological measures—such as galvanic skin response (GSR), facial expression analysis and electroencephalogram (EEG)—may also help researchers to explicate measurement of, and the relationship between, fear and susceptibility.

Fear mediated the relationship between stock UV imagery and sun safe behavior expectations. This finding suggests that researchers should continue to explore the position of fear in the fear appeal research. For example, it is possible that fear appeals exert influence on outcomes by increasing fear directly. Researchers should engage the fear hypothesis by testing fear as a mediator. However, we should note that fear was the only affective construct

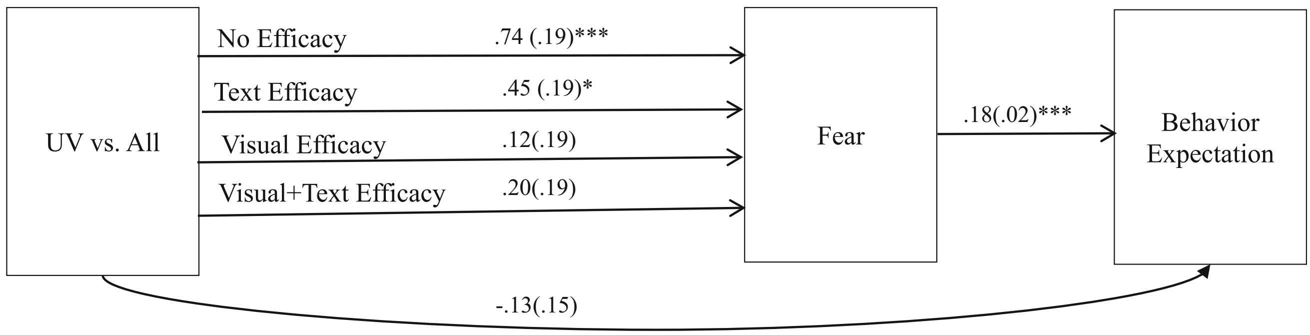

Fig. 2 Moderated mediation—indirect effect at four levels of efficacy condition. *Note* Process Model 8 with 1000 bootstraps. The indirect path through fear was significant in the first two conditions (control and text) but it was no longer significant in the visual and visual + text condition. Control: effect = .14, SE = .04, 95% CI = (.0692, .2099), k^2= .04[a], SE = .01, 95% CI for k^2 = (.0220, .0708). Text: Effect = .08, SE = .04, 95% CI = (.0182, .1536), k^2= .03[a], SE = .01, 95% CI for k^2 = (.0068, .0507). Visual: Effect = .02, SE = .03, 95% CI = (– .0461, .0877), k^2= .01[bc], SE = .01, 95% CI for k^2 = (.0001, .0167). Visual + text: effect = .04, SE = .04, 95% CI = (– .0322, .1064), k^2= .01[bc], SE = .01, 95% CI for k^2 = (.0007, .0282). Pairwise contrasts were used to compare conditional indirect effects. k^2 that do not share superscripts are significantly different, $p < .05$. Notably, the conditional effect for control (k^2 = .04) is significantly different than visual (k^2 = .01) and visual + text (k^2 = .01). * $p < .05$; ***$p < .005$

Table 4 Means and standard errors of mediators and outcomes by visual condition

		Susceptibility	Severity	Self efficacy	Response efficacy	Fear	Behavior expectation
Visual conditions	Sun exposure	4.47 (.08)[a]	5.50 (.07)	5.20 (.06)[a]	5.48 (.07)[ab]	2.39 (.08)[a]	5.27 (.07)
	Sunburn	4.69 (.08)[b]	5.47 (.07)	4.97 (.06)[b]	5.37 (.07)[a]	2.61 (.08)[ab]	5.12 (.07)
	Aging	4.62 (.08)[ab]	5.51 (.07)	5.23 (06)[a]	5.47 (.07)[ab]	2.76 (.08)[bc]	5.23 (.07)
	Mole removal	4.64 (.08)[a]	5.56 (.07)	5.23 (.06)[a]	5.58 (.07)[b]	3.03 (.08)[d]	5.31 (.07)
	UV	4.62 (.08)[ab]	5.55 (.07)	5.12 (.06)[ab]	5.47 (.07)[ab]	3.07 (.08)[d]	5.22 (.07)

Means and standard errors (in parentheses)

Means with different superscripts are significantly different, $p < .05$

measured in the study and the average fear produced was below the midpoint on a 7-point scale. This suggests that fear in public health campaigns might be relatively modest or, in a larger sense, that there might be other emotions in play. Researchers have reported the association of fear appeals with other emotions such as, hope (Nabi & Myrick, 2018) or mixture of sequential emotions such as sadness, fear, joy, and relief (Carrera et al., 2010). Thus, future fear appeal studies should include self-reported as well as physiological measures of multiple discrete emotions so as to explore the role of different discrete emotions in fear appeal message processing.

Two types of visuals were found to generate more fear than others: UV skin damage and mole removal. One image within the mole removal category deserves additional commentary. Image 13 (see "Appendix 5") depicts a young girl with a particular gruesome wound. This image is unaltered—it has not been visually manipulated—and it has been used, and found to be effective at generating fear, by other researchers studying skin damage visuals (Mays & Zhao, 2016). Future research seeking a useful comparison visual to develop and refine alternative visual approaches would be well-advised to consider image 13, notably in situations where replications are challenging. Future studies should also examine mole removal and UV photos with a range of discrete emotions and other message variables such as defensive avoidance, memorability, and novelty to explicate the similarities and differences in impacts that these two categories of visuals create.

In the current study, UV efficacy visual appeal generated higher self-efficacy compared to the combination of UV visual and text. One possible explanation is that the text message could have increased the cognitive demands of the message as it recommended several sun safe behaviors; whereas, the UV efficacy visual focused on only one behavior—sunscreen use (see "Appendix 6 and 7"). Follow-up studies should investigate the veracity of this explanation as well as the underlying mechanisms at play. Moreover, the results also question the moderating role of efficacy messages. Here, we found that, contrary to the proposed hypothesis, the indirect effect through fear was larger in the control and text-only conditions. The exposure to efficacious visual messages generated higher efficacy which then appeared to nullify fear; without that fear, participants had lower sun safe behavior expectations. EPPM assumes that threat message will be effective when there is sufficient efficacy but our analysis suggests that efficacy and threat appeals may interact in different ways—sometimes it might be the case that efficacy messages diffuse threat messages. If true, this has significant implications for fear appeal research. The question becomes, do we want to eliminate fear, or is there a certain level of fear that we want to maintain? Should efficacy temper fear, as opposed to remove it completely? This might also be a dosage effect. The exposure of one UV photo generates fear because it is novel but seeing the second UV photo (i.e., the UV efficacy visual) might have diffused that novelty aspect and diminished the fear. These questions need to be answered in future studies by evaluating the interaction of multiple forms, doses, and types of efficacy messages in subsiding fear and impacting behavioral outcomes (e.g., see Carcioppolo et al., 2013).

Another interesting finding of the study is the effect of sunburn visuals on self-efficacy. Participants in the sunburn visuals condition reported significantly less self-efficacy compared to other visuals except the UV skin damage visual (Table 4). This suggests participants might have believed it is easier to prevent aging and mole removal scars compared to sunburn. One of the striking difference between sunburn visuals and aging and mole removal visuals is the temporality of the threat (Shipp & Aeon, 2018). UV and sunburn visuals depicts immediate damage to the skin, whereas, aging and mole removal visuals show the threat that can happen in the future. It might be the case that people feel more in control of future threats because they are temporally distant. Future research should examine the effect of threat temporality on self-efficacy and sun safe behavior.

The current study has number of limitations, which may be addressed in future studies. First, sun safe behavior expectations was measured instead of behavior, thus the effects seen here may not translate to actual behavior. We should also acknowledge that because the entire study was completed in a continuous series, this might have made the participants' responses vulnerable to demand effects. Future studies could engage this limitation via a Solomon four group design experiment (McCambridge et al., 2014; Solomon, 1949). Moreover, the mediators and outcome variables were all measured at the same point in time (i.e., the posttest) which limits the ability to perform meaningful mediation analysis and might introduce biases in the results (Kline, 2015; Maxwell & Cole, 2007; Tate, 2015). Researchers could design a longitudinal study that explores the impact of a stock UV photo in promoting sun-safe behaviors over time to mitigate these biases. Some UV intervention studies (e.g., Mahler et al., 2013; Stock et al., 2010) have used spectrophotometry that provides an objective measure of skin color, which tracks the actual practice of sun-safe behavior. This could be a superior outcome measure compared to self-report, and a valuable addition to longitudinal evaluations.

A second limitation is the use of self-reported fear measured at a single point in time. Future studies could utilize physiological measures to assess fear and examine how fear manifests and progresses as participants view UV photos. Third, we have only studied the impacts of stock UV photos in the context of sun-safe behavior; future studies can study the impacts of UV photos in promoting other skin cancer prevention behaviors such as skin self-examination. Fourth, the visuals used in this study varied in terms of demographics (i.e., age, sex, race) of the model and we did not study the potential effect of such factors. Future studies can systematically vary the demographics of the models—and perhaps the amount of skin damage (Mahler, 2018)—to understand the impact this might pose. Fifth, our analyses studied the danger control process portion of the EPPM model, but future UV intervention studies could test the full theoretical model of EPPM (including the fear control process). Sixth, some readers might question how participants perceived the UV visual-only efficacy stimuli. That condition did not include explanatory text about the visual or sun safe behavior. To engage this limitation, we examined thought listing from the 555 participants in the visual-only condition. Of those, only 15 participants expressed any confusion or negative thoughts about the visual. Still, it is possible that participants in that condition may have perceived the visual in unexpected ways given the lack of explanatory text.

The current study adds to the literature on UV photo interventions, the EPPM, and visual fear appeals because the findings demonstrate the potential of stock UV visuals in eliciting fear responses that lead to sun safe behavioral practices. This has a practical implication in the use of stock UV visuals in the promotion materials, websites, and social media pages of organizations working to prevent skin cancer. Indeed, stock images like those examined here are commonplace in social media messages, and have been shown to increase attention and response (Vraga et al., 2016). Our findings also have an important implication for fear appeal models such as the EPPM, and for research on visual communication. To that end, the current study utilized a design (multiple message categories with replications) that is rarely encountered in behavioral research. Such designs require relatively large samples, but they also afford researchers numerous analytical opportunities. The current analysis examined the value of stock UV visuals compared to four alternative visual types. Other researchers may find value in carefully examining the other visuals and their impact. A larger goal of the study was to create a resource—including the visuals, data, and approach—to inform and support future research on visual communication, UV visuals, skin cancer, and fear appeals.

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Compliance with ethical standards

Conflict of interest Manusheela Pokharel, Katheryn R. Christy, Jakob D. Jensen, Elizabeth A. Giorgi, Kevin K. John, Yelena P. Wu have no conflicts of interest to declare.

Human and animal rights and Informed consent All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors. Informed consent was obtained from all individual participants included in the study.

Appendix 1: UV skin damage visuals

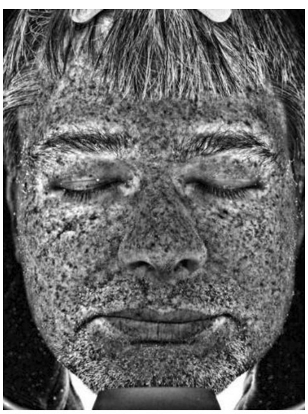


Image 1

Image 2

Image 3

Appendix 2: Sun exposure visuals

Image 4

Image 5

Image 6

Image 9

Appendix 3: Sunburn visuals

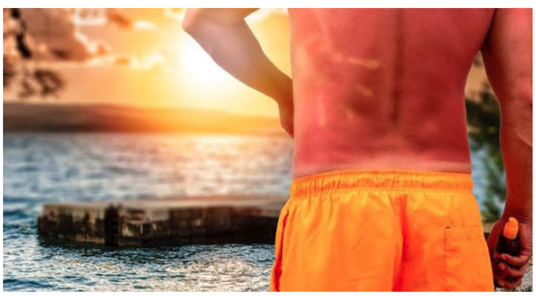


Image 7

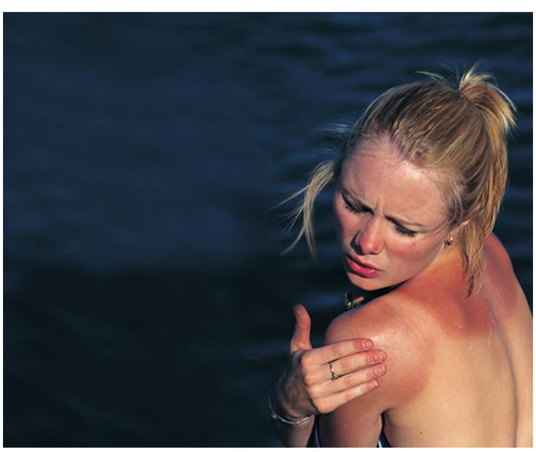


Image 8

Appendix 4: Photo ageing visuals

Image 10

Image 11

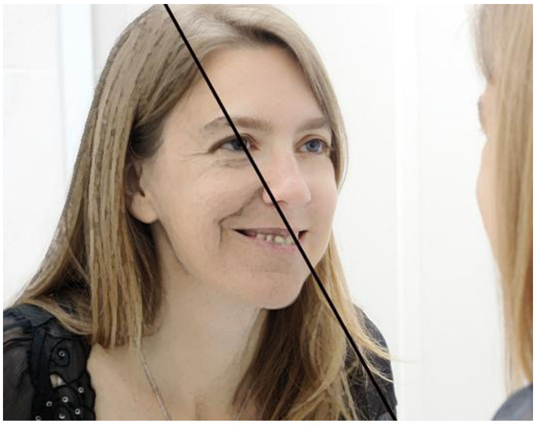


Image 12

Appendix 5: Mole removal visuals

Image 13

Image 14

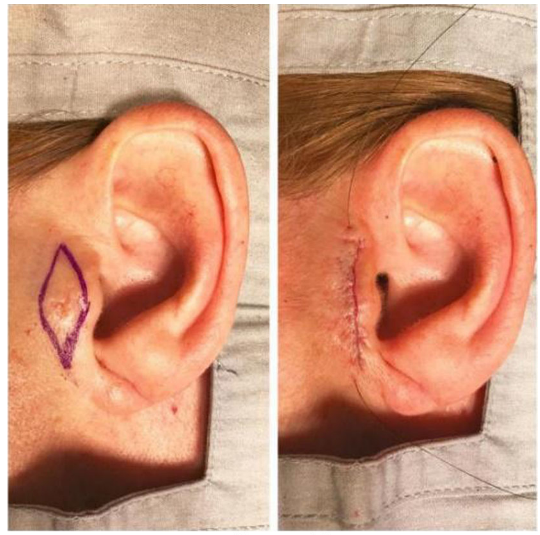


Image 15

Appendix 6: Text efficacy condition stimuli

There are a number of things that you can do to reduce your risk of skin cancer, including:

- Wearing sunscreen.
- Staying out of the sun between 10 AM and 4 PM.
- Wearing protective clothing (e.g., long sleeves, long pants, a broad brimmed hat, sunglasses).
- Staying in the shade.

Next we're going to ask you a bit about the image you just saw.

Appendix 7: Visual efficacy condition stimuli

Appendix 8: Estimated marginal means and 95% confidence intervals: visual conditions × efficacy conditions

Visual condition	Efficacy condition	Dependent variables											
		Susceptibility		Severity		Self efficacy		Response efficacy		Fear		Behavior expectation	
		Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI	Mean (SE)	95% CI
Sun exposure	No efficacy	4.24 (.15)	(3.95, 4.54)	5.29 (.13)	(5.03, 5.55)	4.92 (.13)	(4.67, 5.17)	5.26 (.13)	(5.00, 5.52)	2.24 (.16)	(1.92, 2.56)	5.15 (.14)	(4.88, 5.42)
	Text	4.58 (.15)	(4.28, 4.87)	5.54 (.13)	(5.28, 5.79)	5.35 (.13)	(5.10, 5.59)	5.67 (.13)	(5.41, 5.92)	2.26 (.16)	(1.94, 2.59)	5.32 (.14)	(5.05, 5.59)
	Visual	4.72 (.15)	(4.42, 5.01)	5.79 (.13)	(5.53, 6.04)	5.48 (.13)	(5.24, 5.73)	5.68 (.13)	(5.43, 5.94)	2.47 (.16)	(2.15, 2.80)	5.53 (.14)	(5.26, 5.80)
	Visual + text	4.32 (.15)	(4.03, 4.62)	5.40 (.13)	(5.15, 5.66)	5.07 (.13)	(4.82, 5.31)	5.31 (.13)	(5.05, 5.57)	2.58 (.16)	(2.26, 2.90)	5.08 (.14)	(4.81, 5.35)
Sunburn	No efficacy	4.67 (.15)	(4.37, 4.97)	5.39 (.13)	(5.13, 5.64)	4.80 (.13)	(4.55, 5.04)	5.25 (.13)	(5.00, 5.51)	2.44 (.16)	(2.12, 2.76)	5.00 (.14)	(4.73, 5.27)
	Text	4.70 (.15)	(4.40, 4.99)	5.65 (.13)	(5.39, 5.91)	5.00 (.13)	(4.75, 5.25)	5.53 (.13)	(5.27, 5.79)	2.67 (.16)	(2.34, 2.99)	5.07 (.14)	(4.80, 5.34)
	Visual	4.63 (.15)	(4.33, 4.93)	5.35 (.13)	(5.09, 5.60)	5.08 (.13)	(4.83, 5.32)	5.28 (.13)	(5.02, 5.54)	2.73 (.16)	(2.40, 3.05)	5.20 (.14)	(4.93, 5.47)
	Visual + text	4.75 (.15)	(4.46, 5.05)	5.47 (.13)	(5.22, 5.73)	5.01 (.13)	(4.76, 5.26)	5.43 (.13)	(5.17, 5.69)	2.59 (.16)	(2.27, 2.91)	5.22 (.14)	(4.95, 5.49)
Aging	No efficacy	4.44 (.15)	(4.14, 4.73)	5.57 (.13)	(5.31, 5.83)	5.21 (.13)	(4.96, 5.46)	5.40 (.13)	(5.14, 5.66)	2.38 (.16)	(2.06, 2.71)	5.17 (.14)	(4.90, 5.44)
	Text	4.74 (.15)	(4.45, 5.04)	5.39 (.13)	(5.14, 5.65)	5.06 (.13)	(4.81, 5.31)	5.35 (.13)	(5.09, 5.61)	2.87 (.16)	(2.55, 3.19)	5.04 (.14)	(4.77, 5.30)
	Visual	4.72 (.15)	(4.43, 5.02)	5.69 (.13)	(5.43, 5.94)	5.48 (.13)	(5.23, 5.73)	5.62 (.13)	(5.36, 5.88)	2.85 (.16)	(2.53, 3.17)	5.41 (.14)	(5.14, 5.67)
	Visual + text	4.57 (.15)	(4.27, 4.86)	5.40 (.13)	(5.14, 5.65)	5.17 (.13)	(4.92, 5.41)	5.50 (.13)	(5.24, 5.76)	2.93 (.16)	(2.60, 3.25)	5.31 (.14)	(5.04, 5.58)
Mole removal	No efficacy	4.93 (.15)	(4.63, 5.22)	5.61 (.13)	(5.35, 5.86)	5.28 (.13)	(5.03, 5.53)	5.60 (.13)	(5.34, 5.86)	3.28 (.16)	(2.96, 3.60)	5.22 (.14)	(4.95, 5.49)
	Text	4.48 (.15)	(4.18, 4.78)	5.45 (.13)	(5.20, 5.71)	5.15 (.13)	(4.90, 5.40)	5.54 (.13)	(5.28, 5.80)	3.05 (.16)	(2.73, 3.37)	5.17 (.14)	(4.90, 5.44)
	Visual	4.56 (.15)	(4.26, 4.85)	5.61 (.13)	(5.35, 5.87)	5.19 (.13)	(4.94, 5.44)	5.61 (.13)	(5.35, 5.87)	2.91 (.16)	(2.59, 3.23)	5.38 (.14)	(5.11, 5.65)
	Visual + text	4.59 (.15)	(4.29, 4.88)	5.57 (.13)	(5.31, 5.82)	5.29 (.13)	(5.04, 5.54)	5.55 (.13)	(5.29, 5.81)	2.88 (.16)	(2.55, 3.20)	5.45 (.14)	(5.18, 5.72)
UV	No efficacy	4.80 (.15)	(4.51, 5.10)	5.69 (.13)	(5.43, 5.94)	5.07 (.13)	(4.82, 5.32)	5.53 (.13)	(5.27, 5.79)	3.33 (.16)	(3.00, 3.65)	5.15 (.14)	(4.88, 5.41)
	Text	4.50 (.15)	(4.20, 4.79)	5.52 (.13)	(5.27, 5.78)	5.06 (.13)	(4.81, 5.31)	5.39 (.13)	(5.13, 5.65)	3.16 (.16)	(2.84, 3.48)	5.27 (.14)	(5.00, 5.54)
	Visual	4.56 (.15)	(4.27, 4.86)	5.61 (.13)	(5.36, 5.87)	5.29 (.13)	(5.04, 5.54)	5.57 (.13)	(5.31, 5.82)	2.86 (.16)	(2.53, 3.18)	5.25 (.14)	(4.98, 5.52)
	Visual + text	4.63 (.15)	(4.33, 4.93)	5.61 (.13)	(5.12, 5.64)	5.05 (.13)	(4.80, 5.30)	5.39 (.13)	(5.13, 5.64)	2.94 (.16)	(2.62, 3.26)	5.20 (.14)	(4.93, 5.47)

Means and standard errors (in parentheses)

Appendix 9: Estimated marginal means and 95% confidence intervals for fear: UVvsAll × efficacy conditions

Visual condition	Efficacy condition	Mean (SE)	95% CI
Non-UV conditions	Control	2.59 (.08)	(2.42, 2.75)
	Text	2.71 (.08)	(2.55, 2.87)
	Visual	2.74 (.08)	(2.58, 2.90)
	Visual + text	2.74 (.08)	(2.58, 2.90)
UV condition	Control	3.33 (.16)[a]	(3.00, 3.65)
	Text	3.16 (.16)[ab]	(2.84, 3.49)
	Visual	2.86 (.16)[b]	(2.53, 3.18)
	Visual + text	2.94 (.16)[b]	(2.62, 3.26)

Means and standard errors (in parentheses)

Means with different superscripts are significantly different, $p < .10$. In Non-UV conditions, the means are not significantly different. In UV conditions, fear in the control efficacy condition is significantly greater than in the visual efficacy condition, $p = .04$ and approaching significance in the Visual +Text efficacy condition, $p = .098$

Appendix 10: Simple mediation—tests of indirect effects of EPPM variables (MolevsAll)

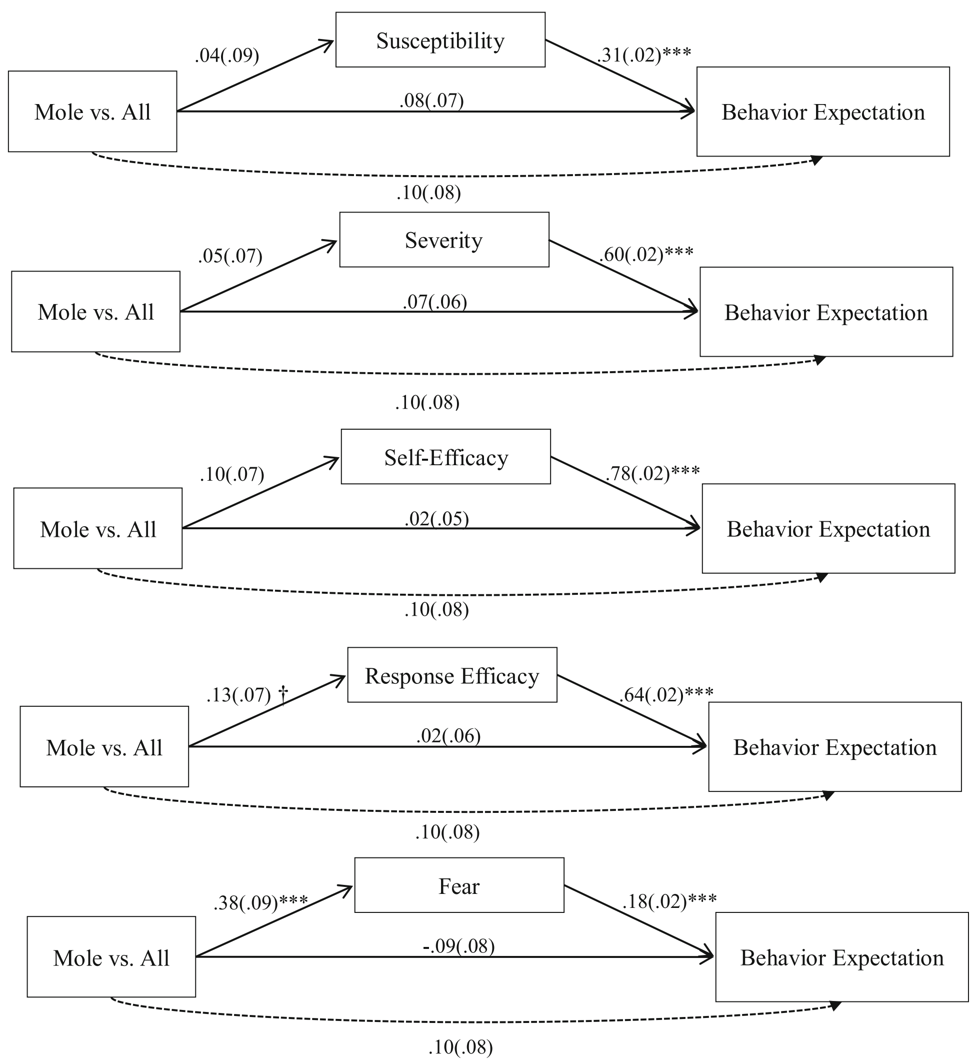
N = 2220	Models without mediator		Models with mediator									
		B	*B*					Bootstrap results for indirect effects (95% CI)		Bootstrap results for indirect effect sizes (95% CI)		
	R^2	*c*	R^2	*c′*	*a*	*b*	*ab*	Lower	Upper	k^2	Lower	Upper
Susceptibility	.00	.10	.12***	.08	.04	.31***	.01	− .0400	.0654	.00	.0000	.0116
Severity	.00	.10	.33***	.07	.05	.60***	.03	− .0570	.1144	.01	.0003	.0381
Self-efficacy	.00	.10	.52***	.02	.10	.78***	.08	− .0273	.1876	.03	.0018	.0711
Response Efficacy	.00	.10	.38***	.02	.13†	.64***	.08	− .0144	.1683	.03	.0025	.0567
Fear	.00	.10	.05***	.04	.32***	.18***	.06*	.0233	.0963	.02	.0068	.0273

Process Model 4 with 1000 bootstraps where each mediator was tested one at a time. Fear is the only significant mediator as the boot confidence interval does not overlap zero. The predictor is the MolevsAll contrast, outcome is behavior expectation

B unstandardized regression weights, *c* total effect of predictor on outcome without the mediator in the model, *c′* direct effect of predictor on outcome while controlling for the mediator, *a* the path between the predictor and the mediator, *b* the path between the mediator and the outcome, *ab* indirect effect of predictor on outcome thorough the mediator, R^2 amount of variance explained by the model, *CI* confidence intervals, k^2 effect size

†$p < .10$; * $p < .05$; ***$p < .001$

Appendix 11: Simple mediation models of the EPPM



Only fear significantly mediated the relation between X (MolevsAll) and Y (Behavior Expectation): effect = .06, Boot *SE* = .02, 95% Boot *CI*: .0233, .0963, Effect size (k^2) = .02

†$p < .10$; ***$p < .001$.

Appendix 12: PROCESS model 4 simple mediation analysis output with visual conditions as predictor, fear as mediator, and behavior expectations as outcome

```
Run MATRIX procedure:

*************** PROCESS Procedure for SPSS Version 3.00 ****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2018). www.guilford.com/p/hayes3

**************************************************************************
Model  : 4
    Y  : Behavior Expectation
    X  : Visual Conditions
    M  : Fear

Sample
Size:  2220

Coding of categorical X variable for analysis:

Visual Conditions        X1        X2        X3        X4
Sun Exposure           .000      .000      .000      .000
Sun Burn              1.000      .000      .000      .000
Ageing                 .000     1.000      .000      .000
Mole Removal           .000      .000     1.000      .000
UV Skin dam            .000      .000      .000     1.000

X1: Sun Burn Visuals contrast with Sun Exposure Visuals
X2: Ageing Visuals contrast with Sun Exposure Visuals
X3: Mole Removal Visuals contrast with Sun Exposure Visuals
X4: UV Skin Damage Visuals contrast with Sun Exposure Visuals

**************************************************************************
OUTCOME VARIABLE: Fear

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .1467      .0215     3.0094    12.1749     4.0000  2215.0000      .0000

Model
             coeff         se          t          p       LLCI       ULCI
constant    2.3889      .0823    29.0169      .0000     2.2274     2.5503
X1           .2166      .1164     1.8603      .0630     -.0117      .4449
X2           .3682      .1164     3.1628      .0016      .1399      .5966
X3           .6400      .1164     5.4971      .0000      .4117      .8683
X4           .6821      .1164     5.8581      .0000      .4537      .9104

**************************************************************************
```

```
OUTCOME VARIABLE: Behavior Expectation

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .2259      .0510     1.9920    23.8007     5.0000  2214.0000      .0000

Model
              coeff         se          t          p       LLCI       ULCI
constant     4.8279      .0787    61.3553      .0000     4.6736     4.9822
X1           -.1878      .0948    -1.9809      .0477     -.3737     -.0019
X2           -.1081      .0949    -1.1385      .2550     -.2943      .0781
X3           -.0828      .0954     -.8682      .3854     -.2698      .1042
X4           -.1801      .0955    -1.8871      .0593     -.3673      .0071
EPPMFear      .1852      .0173    10.7118      .0000      .1513      .2191

************************** TOTAL EFFECT MODEL ****************************

OUTCOME VARIABLE: Behavior Expectation

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .0427      .0018     2.0942     1.0131     4.0000  2215.0000      .3992

Model
              coeff         se          t          p       LLCI       ULCI
constant     5.2703      .0687    76.7381      .0000     5.1356     5.4050
X1           -.1477      .0971    -1.5205      .1285     -.3382      .0428
X2           -.0399      .0971     -.4108      .6813     -.2304      .1506
X3            .0357      .0971      .3677      .7131     -.1548      .2262
X4           -.0538      .0971     -.5543      .5794     -.2443      .1366

************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Relative total effects of X on Y:
       Effect         se          t          p       LLCI       ULCI       c_ps
X1     -.1477      .0971    -1.5205      .1285     -.3382      .0428     -.1021
X2     -.0399      .0971     -.4108      .6813     -.2304      .1506     -.0276
X3      .0357      .0971      .3677      .7131     -.1548      .2262      .0247
X4     -.0538      .0971     -.5543      .5794     -.2443      .1366     -.0372

Omnibus test of total effect of X on Y:
    R2-chng          F        df1        df2          p
      .0018     1.0131     4.0000  2215.0000      .3992
----------

Relative direct effects of X on Y
       Effect         se          t          p       LLCI       ULCI      c'_ps
X1     -.1878      .0948    -1.9809      .0477     -.3737     -.0019     -.1298
X2     -.1081      .0949    -1.1385      .2550     -.2943      .0781     -.0747
X3     -.0828      .0954     -.8682      .3854     -.2698      .1042     -.0572
X4     -.1801      .0955    -1.8871      .0593     -.3673      .0071     -.1245

Omnibus test of direct effect of X on Y:
    R2-chng          F        df1        df2          p
      .0023     1.3194     4.0000  2214.0000      .2604
----------
```

```
Relative indirect effects of X on Y

 ImgCondi     ->     EPPMFear     ->     POSTBEas

       Effect      BootSE    BootLLCI    BootULCI
X1       .0401       .0212       .0004       .0838
X2       .0682       .0219       .0273       .1131
X3       .1185       .0238       .0742       .1689
X4       .1263       .0233       .0841       .1758

Partially standardized relative indirect effect(s) of X on Y:

 ImgCondi     ->     EPPMFear     ->     POSTBEas

       Effect      BootSE    BootLLCI    BootULCI
X1       .0277       .0146       .0003       .0574
X2       .0471       .0151       .0188       .0780
X3       .0819       .0163       .0516       .1161
X4       .0873       .0160       .0585       .1207

*********************** ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95.0000

Number of bootstrap samples for percentile bootstrap confidence intervals:
  5000

----- END MATRIX -----
```

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