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Do Metaphors in Health Messages Work? Exploring Emotional and Cognitive Factors

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Abstract

Health communicators publicize messages that use metaphors to compare abstract health-related concepts to concrete concepts in other domains. Such messages aim to change health attitudes and behavior, but do they work? According to Conceptual Metaphor Theory, metaphors can shape thought by transferring personalized knowledge of a concrete concept to understand and relate to an abstraction, despite their superficial differences. The authors extend this claim to specify emotional and cognitive factors potentially moderating the productivity (and counter-productivity) of metaphoric health messages. A *source resonance* hypothesis predicts that when a message frames a health risk metaphorically in terms of a concrete hazard (versus literally), individual differences in fear surrounding that particular hazard will differentially predict risk-related worry and thus prevention intentions. A *metaphoric fit* hypothesis predicts that a risk metaphor will be more persuasive when the recommended prevention response is itself framed metaphorically as addressing the concrete hazard (versus literally). These hypotheses were supported in three experiments conducted with online, undergraduate, and community samples ($N = 539$). With skin cancer as a case study, the studies tested the impact of messages framing sun exposure and sun-safe practices with or without metaphors of enemy combat. Findings illuminate how, when, and for whom metaphoric messages are persuasive, with theoretical and practical implications for health communication and metaphoric construal.

Keywords

Health communication; conceptual metaphor; cancer; matching; response efficacy

People regularly encounter messages encouraging lifestyle behaviors that reduce the risk of illnesses such as cancer, influenza, and diabetes. But all too frequently these messages fail to inspire action. Whether encouraging people to exercise, floss, or get flu shots, there is considerable scope for improving the power of health messages to motivate lifestyle behavior change (CDC, 2015; Manella, 2016; Troiano et al., 2008). This scope includes sun protection behavior (U.S. DHHS, 2014). The incidence of skin cancer is increasing more rapidly than any other form of preventable cancer (Siegel, Miller, & Jemal, 2015); yet only

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30% of American adults report regularly using sunscreen or wearing sun-protective clothing (Buller et al., 2011).

The current research examines the effectiveness of one communication strategy: Providing metaphors that compare ideas about health to concrete concepts in remote domains. This strategy deserves attention because metaphors are frequently and often haphazardly featured in public health campaigns, product marketing, news reports, and educational materials (Downs et al., 2009; Mukherjee, 2011; Sontag, 1978).

Do such widespread metaphors have the intended effects on health attitudes and behavior? Some experimental evidence suggests they do. Scherer and colleagues (2015) exposed participants to messages framing the flu in terms of concrete hazards such as a wild animal attacking one's health, a weed growing inside one's body, or an invading army. Compared to a literal description of the flu, these metaphoric messages increased intentions to get a flu shot.

Still, there are reasons to question whether metaphors consistently yield benefits, and further, research reveals little about the mechanisms by which metaphoric messages persuade when they do. Conventional wisdom suggests they create an emotional jolt, helping recipients appreciate the urgency of a health risk. Yet Scherer et al. (2015) found no evidence that metaphoric messages increased fear of the flu. Also, Conceptual Metaphor Theory (CMT; Kövecses, 2010; Lakoff & Johnson, 1980), the background theoretical perspective, raises the possibility that persuasive metaphors can be inert and even *backfire*, dampening recipients' concern and response.

To understand the conceptual dynamics of metaphoric thinking, as well as how metaphor may be best utilized in behavior change campaigns, we build on CMT to specify emotional and cognitive factors potentially moderating the productivity, or counter-productivity, of metaphoric health messages. Three studies explore these factors in the context of skin cancer communication across laboratory and field settings.

Background

CMT posits that metaphor is a cognitive tool for understanding—and not just talking about—one concept in terms of a superficially dissimilar concept (Gibbs, 2008; Kövecses, 2010; Lakoff & Johnson, 1980). A metaphor's *target* is abstract and difficult to grasp, whereas its *source* is relatively concrete and easily understood. For example, one might use metaphor to understand the elusive process of recovering from a cold (the target) in terms of a physical journey (e.g., "I've *come a long way*") or escaping restraint (e.g., "It won't *let go*").

Metaphor supports understanding by creating a mapping that uses select elements of a source schema to structure representations of the target. Metaphor use, then, involves transferring source knowledge as a framework for understanding and relating to the target. To illustrate, the mapping created by the metaphor *recovery is a journey* transfers a conceptual template that implies that recovery has a *starting point* and a *destination*, choices are *branching paths*, and difficulties are *obstacles*. Target elements that do not share analogs with a source are downplayed in attention.

Research that manipulates *metaphoric framing*—comparing a message with metaphoric language or imagery with an equivalent literal or alternative-metaphoric message—consistently shows changes in target processing that correspond to source knowledge (Landau, 2017; Landau, Robinson, & Meier, 2014). In one illustrative study (Thibodeau & Boroditsky, 2011), participants who read an article comparing a city's crime problem to an aggressive beast recommended punitive crime-reduction strategies, whereas those who read the same facts framed in disease-metaphoric terms recommended strategies addressing crime's root causes. The messages did not explicitly mention crime reduction strategies, suggesting—in line with CMT—that activated metaphors prompted participants to transfer knowledge of a concrete source to conceptualize a problem in a different domain.

Integrating CMT with Health Communication

How can CMT inform models of health communication? Health risk messages can be effective when they increase recipients' fear or worry that the risk threatens their well-being (Cameron & Chan, 2008; Witte & Allen, 2000). Without a fear-like emotion stemming from the anticipated threat, recipients have less motivation to change their behavior. Simply evoking worry is not enough, however. Persuasive messages portray the recommended behaviors as relevant and effective for addressing the risk (Rogers, 1983; Witte & Allen 2000). From there, we apply CMT to specify two hypotheses regarding the persuasive impact, or lack thereof, of metaphoric health messages.

Source resonance.

Early demonstrations of metaphoric-framing effects showed that messages comparing abstract topics to affectively-charged sources changed target attitudes in source-consistent directions (Ottati, Renstrom, & Price, 2014). Going beyond these direct effects, researchers reasoned that if metaphor creates a systematic conceptual mapping, then it should transfer *personalized* source knowledge (Ottati & Renstrom, 2010). This yields a *source resonance* hypothesis: Exposure to a metaphoric message will affect target processing differently depending on recipients' preexisting conceptions of the source. If, alternatively, metaphor transfers stereotyped representations of generic source concepts (i.e., stripped of personal connotations), then metaphoric messages should not interact with individual differences in source conceptions.

Studies of sociopolitical messages support this hypothesis. When Ottati, Rhoads, and Graesser (1999) framed a senior thesis requirement metaphorically in terms of sports competition (e.g., "*Play ball* with the best" vs. literally), sports enthusiasts carefully evaluated the requirement and were thus more convinced by strong (vs. weak) arguments, whereas sports apathists were less attentive and thus less affected by argument strength. In another study (Landau, Keefer, et al., 2014), a news report comparing a corporate bankruptcy to a vehicle accident (vs. literally) led participants to focus blame on the company's CEO (the figurative driver) and away from other parties, but only if they strongly believed that vehicle accidents are caused by bad drivers (vs. other factors). The vehicle metaphor did not interact with beliefs about other accidents, supporting CMT's claim that metaphor transfers personalized source conceptions to guide target processing.

Spina et al. (2017) extended this work to the health domain. When Latina women read a message advocating Papanicolaou (Pap) smears that compared their body to a family (in which body parts figuratively support one another), higher valuing of collectivism and family loyalty predicted stronger intentions to get a Pap smear. When the message framed the same facts literally, endorsement of these values did not predict intentions.

Metaphoric fit.

The effectiveness of a health message depends on its portrayal of not only the risk, but also the prevention behavior. From a CMT perspective, when people conceptualize a target problem metaphorically in terms of a source problem, they transfer source knowledge to reason about how to address that problem, even though the two problem scenarios are superficially unrelated and may require different approaches. This yields a *metaphoric fit* hypothesis: When a message frames a target problem metaphorically in terms of a concrete problem, it will be more persuasive when it also frames the proposed solution metaphorically as addressing that concrete problem (vs. literally or using another metaphor).

Studies of health messages support this hypothesis. In Keefer et al. (2014), an article framing depression metaphorically as a problem of being physically down increased the perceived efficacy of an anti-depressant medication framed metaphorically as elevating, but not a medication framed in literal terms. Similarly, Hauser and Schwarz (2015) reasoned that military metaphors for cancer imply a strategic approach to cancer treatment that is primarily aggressive and not restrained. Accordingly, participants who read a military-metaphoric framing of cancer were less motivated to engage in self-limiting behaviors (e.g., dieting) that reduce their cancer risk. When viewed through the lens of military strategy, certain behaviors seem poorly suited to fight the “war on cancer,” even though these behaviors may be beneficial.

Despite the potential of the *source resonance* and *metaphoric fit* hypotheses to provide insights into health communication, important questions remain. Little is known about whether metaphoric framing effects are moderated by individual variability in the source’s *emotional* resonance—specifically, fear-related emotions like worry. This is an important question because worry is a key catalyst of health prevention behavior. Further, evidence-based best practices stipulate the importance of fostering, via messaging, a coherent understanding of why and how recommended protection behaviors work to address a particular risk (Cameron et al., 2012; Hall et al., 2004; Lee et al., 2011). Thus, the current studies focus on whether response framings elaborate (in either metaphoric or literal terms) how the recommended response protects against the health risk.

Skin Cancer Communication

One obstacle to persuasion in the context of skin cancer communication is that, for many people, the anticipated threat of skin cancer seems abstract—invisible, indeterminate, and remote from the here and now (Hay, Buckley, & Ostroff, 2005). Consequently, a message portraying UV risk in abstract terms may fail to increase fear-related emotions, such as worry, that motivate preventive action. In contrast, a message that frames UV risk metaphorically in terms of a concrete hazard may be effective under certain conditions at

eliciting an energizing level of worry. Given that the effects of health risk messages on sun protection efforts are partly mediated by worry (Kiviniemi & Ellis, 2014), a metaphoric message has the potential to strengthen or undermine sun-safe intentions. In three studies exploring this possibility, participants were randomly assigned to read a message framing the sun metaphorically as an enemy determined to strike their body with UV rays or in equivalent literal terms.

The current analysis specifies two conditions under which a metaphoric message will *not* work as intended and may even backfire. First, the *source resonance* hypothesis suggests that, among recipients prone to fear enemies, a message framing the sun as an intentional enemy will be more effective, or at least equally effective, as an equivalent literal message. For recipients relatively unafraid of enemy confrontation, however, the enemy-metaphoric message will not increase worry and prevention intentions compared with a literal message, and may even decrease them. Studies 1 and 3 tested these predictions by having participants complete a pretest measure of their fear of enemies and assessing whether it moderated the metaphoric framing effects on worry, protection intentions, and (in Study 3) monetary valuing of sunscreen.

Second, the *metaphoric fit* hypothesis suggests that the effects of risk framing will be constrained by response framing. In a separate manipulation of response framing, sun-safe behaviors were framed either literally as a beneficial precaution or metaphorically as a defense against an enemy's strikes. A message framing UV risk metaphorically as an enemy assault *and* the recommended response metaphorically as averting assault was predicted to elevate worry and response intentions at levels greater than, or equal to, a message framing the risk and response in literal terms. In contrast, a message presenting mismatched framings —one addressing a metaphoric risk with a literal response or a literal risk with a metaphoric response—was predicted to *decrease* worry and response engagement.

All studies tested mediated moderation models to determine whether skin cancer worry mediated the moderating effects (of enemy fear, response framing, or both) on the impact of risk framing on sunscreen intentions.

Simmons et al.'s (2011) procedures for determining sample size led us to seek 30 observations minimum per condition. For Study 1 (online) and Study 3 (field), we continued collecting data until compensation funds were exhausted; for Study 2 (laboratory), we collected data until the end of the semester. We conducted all studies in a single wave and analyzed data only after the sample size target was met. We report all measures, manipulations, and exclusions in these studies. All studies were approved by the applicable university Institutional Review Board.

Internal validity and generalizability were informed by including critical comparison conditions, converging operations (e.g., diversified messages and behavioral intention measures), and samples recruited from online, undergraduate, and community populations.

Study 1: Source Resonance

Guided by the *source resonance* hypothesis, Study 1 tested whether a health risk metaphor has differential effects depending on recipients' fear of that metaphor's source. Discriminant analyses tested whether the risk metaphor's impact was moderated by fear of that source, specifically, or by fear of other hazards more generally.

Sample

Participants were 187 adults who self-selected to complete the study in response to a posting on the Mechanical Turk website (compensation = $1.00). Data from 18 participants were excluded from analysis (12 failed comprehension checks by reporting being in the wrong message condition; 6 completed the study on a phone that distorted message presentation). The final sample (N = 169) included 99 men and 69 women (1 reported Other) ages 18 to 64 (M = 33.54, SD = 11.39) who identified as White (72.2%), Asian (10.1%), Black (7.1%), or Other (10.6%). Ethnicity was assessed separately, with 10.1% reporting Latino and 89.9% reporting non-Latino. In terms of highest education level, 13% completed high school or less; 40.2% completed some college, technical training, or an associate degree; and 46.7% completed a college degree or higher.

Procedure and Materials

The study was presented using Qualtrics software (Provo, Utah). In this and the subsequent studies, participants provided informed consent for a study described as investigating people's views on health issues.

Fear of enemy combatants and vehicle accidents.—Participants indicated their agreement with three statements: "The possibility that I could get in a fistfight is frightening; I don't get too scared by physical confrontations (reverse scored); The thought that an enemy is out to physically attack me makes me extremely uncomfortable" (1 = *Strongly disagree*, 7 = *Strongly agree*; α = .80). To ascertain if the predicted effects were specific to enemy fear, we asked participants to respond to parallel statements assessing their fear of vehicular accidents (e.g., "The possibility that I could get in a vehicle accident is frightening"; α = .84). The six items were counterbalanced to control for possible order effects.

Risk framing manipulation.—After completing filler questionnaires intended to distract from the study's focus on enemy fear, participants viewed a "Skin Cancer and Sun Protection" information page that described in purposefully complex scientific terms the relationship between UV exposure and skin cancer, accompanied with technical illustrations of anatomy and cell mutation. This page was intended to set the stage for participants to receive a message that summarized, in lay terms, the nature and significance of UV risk.

Qualtrics randomly assigned some participants (n = 83) an enemy-metaphoric message in which an image of a sun bearing a menacing facial expression (Figure 1–a) was paired with the following text:

> "You know how sometimes people will get it in their heads to hurt someone else, and nothing will seem to stop them? That is what the sun is like. It is not your friend, it is your enemy. It is out to get you. As soon as you walk outside in the sun, it starts attacking your skin with UV rays. The sun is out to destroy your skin cells and blood vessels. The sun has the power to really hurt you, and it won't be stopped by clouds or snow or cold air. It keeps piercing and zapping your skin, weakening your resistance to skin cancer."

The other participants (n = 86) read a parallel message, matched in length and tone, that portrayed UV risk in literal terms. An unadorned sun image (Figure 1–b) was paired with the following text:

> "You know how some things are bad for people, and they keep putting people's health at risk? That is what the sun is like. The sun keeps life going, but its rays create a serious health risk that you should be concerned about. They can lead to skin damage on your body. As soon as you walk outside in the sun, your skin absorbs UV rays. This switches on unhealthy changes in your skin cells and blood vessels. Even on days that are cloudy, snowy, or cold, UV exposure leads to skin damage and puts you at risk for skin cancer."

Skin cancer worry measure.—Seven items adapted from Cameron (2008) assessed general worry (e.g., "To what extent are you worried about skin cancer?") and conditional worry should one not use sun protection (e.g., "If you didn't use sun protection regularly in the future, to what extent would you be worried about getting skin cancer?"; 1 = *Not at all*, 7 = *Extremely*). Because absolute and conditional worry were highly correlated (r = .82, p < .001), we averaged responses to form composite worry scores (α = .96).

Sun protection intentions measure.—Five items adapted from the Sun Protective Behaviors Index (Cokkindes et al., 2001) assessed sun protection intentions. Participants were asked to imagine going outside on sunny summer days and indicate their intentions to stay in the shade, wear sunglasses, wear long sleeves, wear a hat, and apply sunscreen. They also imagined going outside on cloudy days and indicated their intentions to apply sunscreen. Responses were made on a 5-point scale (1 = *Never*; 2 = *Rarely*; 3 = *Sometimes*; 4 = *Often*; 5 = *Always*) and averaged (α = .68).

In this and the subsequent studies, participants completed demographic and comprehension-check questions, including whether they were earlier presented with a message describing the sun as an enemy or a harmful health risk. They were debriefed, thanked, and provided additional information about skin cancer and prevention.

Results

Table 1 presents bivariate correlations between study variables.

Skin cancer worry.—Following recommendations of Aiken and West (1991), we conducted multiple regression analyses with Enemy fear (centered) and Risk framing condition (dummy coded) entered as predictor variables in Step 1 and their interaction entered in Step 2. Submitting skin cancer worry to this analysis returned a main effect of

Enemy fear, β = .30, *SE* = .07, *t*(166) = 3.98, *p* < .001, and no effect of Risk framing condition, *t* < 1, *p* = .57. The two-way interaction was significant, β = .27, *SE* = .07, *t*(165) = 3.70, *p* < .001, ΔR^2 = .07, and contributed significantly to the total variance explained.

Post-hoc analyses (Figure 2) supported predictions: Among participants with low enemy fear (−1 *SD*), the enemy-metaphoric risk framing elicited lower worry compared to the literal framing, β = −.32, *SE* = .31, *t*(165) = 3.07, *p* = .003. In contrast, among participants with high enemy fear (+1 *SD*), the enemy-metaphoric framing elicited greater worry than the literal framing, β = .21, *SE* = .30, *t*(165) = 2.15, *p* = .03. Looked at differently, when UV risk was framed literally, there was no relationship between enemy fear and skin cancer worry, *t* < 1, *p* = .52. In contrast, after exposure to an enemy-metaphoric risk framing, enemy fear positively predicted worry, β = .51, *SE* = .11, *t*(81) = 5.28, *p* < .001.

Parallel regression analyses replacing Enemy fear with Vehicular fear revealed a main effect of Vehicular fear, β = .37, *SE* = .07, *t*(166) = 5.16, *p* < .001, but no interaction, β = .12, *SE* = .07, *t*(165) = 1.62, *p* = .11. In addition, the predicted Enemy fear × Risk framing interaction (β = .28, *SE* = .07, *t*(164) = 4.05, *p* < .001) and corresponding post-hoc comparisons remained significant when Vehicular fear was entered as a covariate.

Sun protection intentions.—Submitting sun protection intentions to the same regression analyses revealed no main effect of Enemy fear (*t* < 1, *p* = .43) and a marginal main effect of Risk framing condition, β = −.15, *SE* = .05, *t*(166) = 1.90, *p* = .059. The two-way interaction was significant, β = .16, *SE* = .03, *t*(165) = 2.09, *p* = .038, ΔR^2 = .03.

Post hoc analyses (Figure 3) revealed that among low enemy fear participants, the enemy-metaphoric risk framing led to higher intentions compared to the literal risk framing, β = .31, *SE* = .15, *t*(165) = 2.84, *p* = .005. For high enemy fear participants, the framing conditions did not differ, *t* < 1, *p* = .95. Looked at differently, when participants read a literal risk framing, their enemy fear did not predict their intentions, *t* < 1, *p* = .45. When UV risk was framed metaphorically as an enemy, low enemy fear predicted low protection intentions, β = .24, *SE* = .05, *t*(81) = 2.21, *p* = .03.

Parallel regression analyses with Vehicular fear revealed no main or interaction effects, *t*s < 1.04, *p*s > .30. Including Vehicular fear as a covariate left the Enemy fear × Risk framing interaction intact (β = .16, *SE* = .03, *t*(164) = 2.08, *p* = .039).

Mediation analyses.—To examine whether the observed interactive effect on sun protection intentions was mediated by skin cancer worry, we followed a bootstrapping procedure using the SPSS PROCESS macro with 5,000 iterations (model 8; Hayes, 2013). The indirect effect of Enemy fear × Risk framing on intentions through worry was significantly different from 0, 95% CI = [.0470, .1919]. Within the mediated moderation model (Figure 4), the direct effect of the interaction was not significantly different from 0, 95% CI = [−.0883, .1677]. The models further indicate that for those low in enemy fear, exposure to the enemy-metaphoric framing predicted lower worry, which predicted lower intentions, 95% CI = [−.3747, −.0582]. In contrast, for those high in enemy fear, the

metaphoric framing predicted higher worry, which predicted higher intentions, 95% CI = [.0347, .2855].

Study 1 supports the *source resonance* hypothesis. Participants with a low (vs. high) fear of enemy confrontation responded to the enemy-metaphoric (vs. literal) message with *lower* worry about skin cancer, and through such trivialization, had lower intentions to engage in sun-safe behaviors. For those high in enemy fear, the enemy-metaphoric (vs. literal) message induced higher worry, and though there was not a direct effect on protective intentions, protective intentions were increased indirectly through elevated worry.

This moderation effect supports CMT's claim that a metaphor transfers *personalized* source knowledge and feelings. An alternative interpretation is that trait levels of worry or anxiety moderated responses to the metaphoric message. Three findings counter this possibility. First, individual differences in enemy fear did not moderate responses to the literal message describing a serious health risk. Second, trait fear of vehicle accidents, while predicting worry, did not predict preventive intentions nor did it interact with message condition to predict worry or intentions. Third, controlling for vehicle fear did not weaken the interactive effects of enemy fear and message condition on worry or intentions. A more likely interpretation is that the enemy metaphor prompted people to transfer their feelings about enemy confrontation, specifically, to understand the target health risk.

Still, it is important to acknowledge that among those high in enemy fear, the metaphor elicited worry but it did not increase intentions on its own (this effect only emerged through worry). One explanation for this pattern derives from the hypothesized role of *metaphoric fit* in health message efficacy: To mobilize prevention efforts, a message comparing a risk to a concrete hazard may be less effective, and even counterproductive, if the recommended response is not itself framed as addressing that concrete hazard. Study 2 explores this possibility.

Study 2: Metaphoric Fit

Study 2 tested predictions that when a message frames a risk metaphorically as a concrete hazard, participants will engage with a response framed in matching metaphoric terms as warding off that hazard. In contrast, they will devalue a literally-framed response that does not address the hazard (despite the framing being technically irrelevant to judging response efficacy). To test these *metaphoric fit* predictions, Study 2 combined Study 1's risk-framing manipulation (enemy-metaphoric vs. literal) with a response-framing manipulation (armor-metaphoric vs. literal).

Sample

Participants were 192 Midwestern undergraduates who participated for partial course credit. Data from 13 participants were excluded from analysis (10 reported that English was not their primary language and had difficulty understanding instructions; 2 did not finish the experiment because their computer froze; 1 was a friend of the experimenter and expressed suspicion about the study's purpose). The final sample (N = 179) included 64 men and 115 women ages 18 to 43 (M = 19, SD = 2.33) who identified as White (81.6%), Asian (7.8%),

Black (8.4%), or Other (2.2%). Ethnicity was asked separately, with 5.6% reporting Latino and 94.4% reporting non-Latino.

Procedure and Materials

Risk framing manipulation.—As in Study 1, participants were presented with filler questionnaires and a technical overview of UV risk and sun protection before being randomly assigned either the enemy-metaphoric UV framing or the literal framing.

Response framing manipulation.—Some participants were randomly assigned a second message framing sunscreen metaphorically as combat armor. The message featured an image of armor (Figure 5) and the following text:

> "Regular application of sunscreen is an armor that decreases the risk of getting skin cancer. Shielding your skin from UV exposure can help you stay healthy. If you use sunscreen with SPF 15 or higher, you put on a thick protective cover that keeps your skin healthy underneath. The higher the SPF you use, the thicker the armor that blocks the sun's rays. It helps to have the entire suit of armor: Wear clothing that shields your arms and legs; wear a hat with a wide brim to protect your face and neck; and wear sunglasses that block out both UVA and UVB rays."

The other participants received a message framing sunscreen in literal terms. They viewed an image of a sunscreen bottle (Figure 5) and the following text:

> "Regular application of sunscreen decreases the risk of getting skin cancer. Protecting your skin from UV exposure can help you stay healthy. If you use sunscreen with SPF 15 or higher, you increase your chances of avoiding cell damage and living longer. The higher the SPF you use, the more you will be protected from the effects of the sun's rays on your health. There are other ways to reduce UV exposure: Wear clothing that covers your arms and legs; wear a hat with a wide brim to shade your face and neck; and wear sunglasses that block both UVA and UVB rays."

Skin cancer worry measure.—Given the substantial correlation between absolute and conditional worry in Study 1, and the present study's focus on worry that might arise from *not* using sun protection, we had participants respond to a single item measuring conditional skin cancer worry: "If you didn't use sun protection regularly in the future, to what extent would you be worried about getting skin cancer?" (1 = *Not at all*; 7 = *Extremely*).

Sunscreen intentions measure.—Because the response framing messages emphasized sunscreen use, the behavioral intention measure focused on sunscreen intentions rather than sun protection intentions more broadly. Three items—two adapted from Study 1 and one new—assessed sunscreen intentions: "In the future, how often do you intend to use sunscreen when you go outside? In the next month, when you are going outside on a sunny day for more than 15 minutes, how often do you plan to apply sunscreen regularly? In the future, how often do you intend to use sunscreen on cloudy days?" (1 = *Never*; 2 = *Rarely*; 3 = *Sometimes*; 4 = *Often*; 5 = *Always*; α = .83).

Worry and intention scores positively correlated, $r = .48$, $p < .001$.

Results

Skin cancer worry.—Submitting conditional worry scores to a 2(Risk framing) × 2(Response framing) ANOVA returned the predicted interaction, $F(1, 175) = 5.60$, $p = .02$, partial-$\eta^2 = .03$ (for the Risk framing main effect, $F = .75$, $p = .39$, partial-$\eta^2 = .004$; for the Response framing main effect, $F = .06$, $p = .81$, partial-$\eta^2 = .000$).

The pattern of means (Figure 6) and pairwise comparisons (Fisher's LSD) support predictions about metaphoric fit. After reading a message framing UV risk metaphorically as an enemy confrontation, participants reported greater worry about their health *without* the protection of sunscreen when sunscreen was itself framed in matching metaphoric terms as armor versus mismatching literal terms ($n = 45$, $M = 4.89$, $SD = 1.70$ vs. $n = 43$, $M = 4.23$, $SD = 1.77$), $F(1,175) = 4.50$, $p = .04$, partial-$\eta^2 = .03$. If the message instead framed UV risk in literal terms, worry did not differ in response to metaphoric vs. literal response framing ($n = 47$, $M = 4.51$, $SD = 1.49$ vs. $n = 44$, $M = 5.05$, $SD = 1.67$), $F(1,175) = 2.29$, $p = .13$, partial-$\eta^2 = .01$.

Also as predicted, presenting a risk metaphor backfired when paired with a response framed in literal terms. This message induced *lower* worry ($M = 4.23$) compared to a message framing risk and response without metaphors ($M = 5.05$), $F(1,175) = 5.07$, $p = .03$, partial-$\eta^2 = .03$.

Sunscreen intentions.—Submitting sunscreen intention scores to the same two-way ANOVA revealed no main effect of Risk framing ($F(1, 175) = 1.97$, $p = .16$, partial-$\eta^2 = .01$) and a marginal main effect of Response framing condition, such that messages framing sunscreen metaphorically (vs. literally) strengthened sunscreen intentions, $F(1, 175) = 3.09$, $p = .08$, partial-$\eta^2 = .02$). This was qualified by the predicted two-way interaction, $F(1, 175) = 4.54$, $p = .03$, partial-$\eta^2 = .03$.

The pattern of means (Figure 7) again reveals diverging consequences of metaphoric fit. A metaphoric risk framing increased sunscreen intentions when combined with a metaphoric (vs. literal) sunscreen response framing ($n = 45$, $M = 2.60$, $SD = .95$ vs. $n = 43$, $M = 2.08$, $SD = .86$), $F(1, 175) = 7.43$, $p = .007$, partial-$\eta^2 = .04$. If the message instead framed UV risk in literal terms, sunscreen intentions did not differ between metaphoric vs. literal response framing ($n = 47$, $M = 2.50$, $SD = .91$ vs. $n = 44$, $M = 2.55$, $SD = .81$), $F(1, 175) = .07$, $p = .79$, partial-$\eta^2 = .00$.

Notably, the same risk metaphor *decreased* prevention intentions when combined with a literal response ($M = 2.08$) compared to a message that used no metaphors ($M = 2.55$), $F(1, 175) = 6.07$, $p = .02$, partial-$\eta^2 = .03$.

Mediation.—As in Study 1, the SPSS PROCESS macro (with 5,000 bootstrapped resamples) was used to test whether the increase in conditional worry produced by the interaction of risk and response framing mediated the observed effect on sunscreen intentions (with the two framing main effects as covariates). The resultant bias-corrected

confidence interval revealed a significant indirect effect, 95% CI = [.0492, .5811]. Furthermore, the direct effect between the framing interaction and sunscreen intentions was not significant, $b = .27$, $SE = .24$, $t(174) = 1.14$, $p = .26$ (Figure 8).

Whereas Study 1 showed that metaphoric message efficacy depends on personalized emotions surrounding the source, Study 2 reveals the moderating role of metaphoric fit. A message framing UV risk metaphorically, and a recommended sun-safe response with a matching metaphor, led participants to report more worry about their skin cancer risk should they not apply sunscreen regularly (i.e., conditional worry). Consequently, they reported stronger intentions to use sunscreen.

In contrast, a message combining mismatching risk and response framings—in particular, an enemy-metaphoric framing of UV exposure and a literal framing of sunscreen—decreased conditional worry and protective intentions compared to a message containing no metaphors at all. In response to the former message, participants presumably reasoned that if the sun is a malevolent enemy, then sunscreen framed in its own, plain terms is ill suited to counter that threat. These findings support CMT's claim that a message-cued metaphor prompts people to transfer problem-solving heuristics from the source to the target—even when they are, strictly speaking, unrelated.

Study 3: Source Resonance & Metaphoric Fit

Study 3 had several goals. First, it aimed to test the *source resonance* and *metaphoric fit* hypotheses simultaneously. Integrating these hypotheses gives rise to a predicted, mediated moderation model of source fear, risk framing, and response framing effects on worry and prevention motivation. Participants disposed to worry about enemy confrontations should respond to an enemy-metaphoric framing of the sun with increased motivation to engage in sun-safe behaviors, but only when those practices are themselves framed with a metaphor of fending off an enemy attack. In contrast, the message should not motivate prevention if either condition is missing: If participants are relatively unafraid of the metaphor's source; or if risk and response framings mismatch (either metaphoric risk / literal response or literal risk / metaphoric response).

Second, Study 3 sought to extend ecological validity. Young adults (sampled in Study 2) are an important population to target for sun-safe behavior given they often engage in high UV exposure and face escalating levels of skin cancer risk (Christenson et al., 2005). The MTurk sample from Study 1 offers diversity and attests to conceptual applicability beyond student samples. Yet both studies fall short of directly informing whether metaphors work as people face high-risk environments. Thus, Study 3 is the first (to our knowledge) to test the impact of metaphoric health messages in the field. The study was conducted at recreational areas in Central California during the summertime, when daily temperatures average 90–95 degrees (U.S. Climate Data, 2016) and UV radiation levels are very high (averaging 9 on the 11-Point UV Index; EPA, 2016).

Study 3 also diversified the message details to feature another metaphor for sun protection behaviors. In the context of a more graphically sophisticated presentation to better

approximate professional health communications, the protection message framed sunscreen as a member of a team of superhero protectors dedicated to fending off the sun's attacks. Further, the metaphoric risk portion included an image of an enemy sun with a more intensely menacing expression.

Finally, Study 3 extended the assessment of protection motivation by including a behavioral measure of willingness to pay for sunscreen. Willingness-to-pay is a standard measure in health promotion and services research (Olson & Smith, 2001) and has been used to test the efficacy of health communication strategies (Cameron et al., 2012). The amount one is willing to pay indicates the maximum monetary value of the product, with higher values reflecting greater interest in purchasing the product.

Sample and Design

Adults (N = 186) were recruited while they recreated at lakeside beaches, fairgrounds, and parks in central California. Those who completed only the pre-manipulation measures before returning the questionnaire (n = 2) or who had been diagnosed with skin cancer (n = 10) were excluded from the analyses. The final sample (N = 174) included 73 men and 101 women ages 18 to 87 (M = 34.72, SD = 15.62) who identified as Non-Hispanic White (46.1%), Hispanic (34.8%), Asian (12.1%), Black (4.2%), or Other (2.8%). In terms of highest education level, 19.3% completed high school or less; 48.8% completed some college, technical training, or an associate degree; and 31.9% completed a college degree or higher. Participants received two small gifts, a flying disc and a sunscreen sample, in appreciation for their participation.

Participants were randomly assigned to view one of four messages corresponding to a Risk framing × Response framing factorial: Enemy-metaphoric risk/Superheroes-metaphoric protection (n = 40); Enemy-metaphoric risk/Literal protection (n = 41); Literal Risk/Superheroes-metaphoric protection (n = 47); Literal Risk/Literal protection (n = 46).

Procedure and Materials

Participants completed the enemy fear measure used in Study 1 along with filler items intended to distract from the study's focus on enemy fear. Next, they read an information flyer called "Sun Facts." It was explained that a local agency had designed the flyer to increase the awareness of adults and youth about sun exposure and the agency wanted consumer feedback on it. The flyers were identical across the four conditions except for the risk framing and response framing manipulations. All four flyers began with the following introduction:

> "Did you know? Although the sun is necessary for life, too much sun exposure can lead to health problems such as skin cancer. More than 1 million people in the United States are diagnosed with skin cancer each year, making it the most common form of cancer in the country. People with fair skin are at particular risk, but everyone—regardless of race or ethnicity—is at risk for skin cancer after too much sun exposure."

Risk framing manipulation.—For the conditions with enemy-metaphoric risk framing risk, the flyers presented an image of a sun with an angry facial expression (Figure 9, Panel A) and the following text:

> "The fact is this: The sun can be your enemy, not your friend. As soon as you walk outside, it's waiting to attack you. It strikes your skin with ultraviolet (UV) radiation, including a one-two punch of UVA and UVB rays. The sun beats on your skin with these rays, destroying skin cells and blood vessels while sabotaging your immune system. The sun has the power to cause serious damage to your skin, and it cannot be stopped by clouds, wind, or cold air. It keeps blasting out UV rays that zap your skin, weakening your resistance to skin cancer. Your risk increases every time the sun's rays darken your skin."

For the conditions with literal framing of UV risk, the flyers presented the image of the sun without the facial expression (Figure 9, Panel B) and the following text:

> "The fact is this: The sun is a serious hazard that you should be concerned about. As soon as you walk outside, sun exposure can lead to skin damage. When your skin is exposed to the sun, it absorbs ultraviolet, or UV radiation, including a combination of UVA and UVB rays. The absorption of UV rays switches on unhealthy changes in your skin cells and blood vessels. It can also weaken your immune system. Even on days that are cloudy, windy, or cold, UV exposure can lead to serious skin damage. This damage can put you at risk for skin cancer. Your risk increases every time sun exposure leads to darker skin."

Response framing manipulation.—The flyer then presented information about sun protection with protective items framed either metaphorically as superheroes or literally as items. The superheroes-metaphoric message presented a cartoon image of a team of superheroes representing sunscreen, long clothing, hats, and sunglasses (Figure 9, Panel C) and the following text:

> "The second fact is this: A team of superheroes is here to protect you. This team includes sunscreen, long clothing, a wide-brimmed hat, and sunglasses. Smart and vigilant, they look out for you by shielding your skin, keeping it safe and healthy. Include a sunscreen with a sun protection factor, or SPF, of 15 or higher on your superhero team: The higher the SPF, the more your sunscreen can fight off the sun's rays. Call on the whole team for the most protection. Long clothing shields your arms and legs; a wide-brimmed hat keeps watch over your face and neck; and sunglasses tackle both UVA and UVB rays before they reach you."

The literal message about sun protection items presented an image with a bottle of sunscreen, long-sleeved shirt, hat, and glasses (Figure 9, Panel D) and the following text:

> "The second fact is this: Several items can be used to protect your skin. These items include sunscreen, long clothing, a wide-brimmed hat, and sunglasses. Easy to use, they can reduce your risk of skin cancer by protecting your skin, enabling you to keep it healthy. Include a sunscreen with SPF 15 or higher: The higher the SPF, the more you can avoid the effects of the sun on your skin. Use all four items for the

most protection. Wear long clothing to cover your arms and legs; a wide-brimmed hat to shade your face and neck, and sunglasses that screen out both UVA and UVB rays to keep yourself healthy."

Participants then completed the dependent measures. Single-item versions of these measures were used to minimize completion times in light of the competing motivations of participants to resume their recreational activities.

Skin cancer worry measure.—Participants completed the measure of conditional worry about skin cancer used in Study 2.

Sunscreen intentions measure.—Intentions to use sunscreen were assessed with an item from Study 2: "In the next month, when you are going outside on a sunny day for more than 15 minutes, how often do you plan to apply sunscreen regularly?" (1 = *Never*; 2 = *Rarely*; 3 = *Sometimes*; 4 = *Often*; 5 = *Always*).

Willingness to pay for sunscreen measure.—Participants indicated their monetary valuing of sunscreen in response to the following instructions: "For a 10-ounce bottle of sun block of SPF 35 or greater, how much would you pay? If you have access to free or discounted sun block, please imagine that you did not have free or discounted access, and that you have to pay for sun block yourself." The scale provided values ranging in dollar increments from $1 to $10.

Results

Bivariate correlations between study variables are presented in Table 2.

Skin cancer worry.—Multiple regression analysis was used to test whether Enemy fear moderates the influence of Risk framing and Response framing on skin cancer worry. The models included Enemy fear (centered), Risk framing, and Response framing main effects in Step 1; their two-way interaction terms entered in Step 2; and the three-way interaction term added in Step 3. Enemy fear positively predicted skin cancer worry in all three steps (at Step 3, β = .45, *SE* = .21, $t(166) = 2.16$, $p = .03$). No other main or two-way interaction effects were significant at any of the three steps (ts < .88, ps > .38).

The three-way interaction accounted for a significant increment in the total variance explained; β =.49, *SE* = .21, $t(166) = 2.33$, $p = .02$, $\Delta R^2 = .03$. Figure 10 shows the patterns of the estimated means (calculated using −1 *SD* and +1 *SD* values for enemy fear) illustrating how Enemy fear moderates the Risk framing × Response framing interaction effect.

Simple slopes analyses supported *source resonance* and *metaphoric fit* hypotheses. For participants high in enemy fear, matching metaphoric framings of risk and response did not undermine worry or intentions compared to matching literal framings (although metaphor did not enhance message effectiveness; compare bars 5 and 8). However, metaphorically framing UV risk as an enemy sun and sun protection in literal terms (vs. with the corresponding superhero metaphor) *decreased* skin cancer worry (slope of the line

connecting bars 5 and 7). Similarly, for high enemy fear participants, presenting risk in literal terms alongside a metaphorical framing of superhero protection led to less worry than when such risk was paired with literal protection (slope of the lines connecting bars 6 and 8). While these two slopes differed significantly for participants high in enemy fear ($t = 2.34$. $p = .02$) the two sets of comparable slopes (connecting bars 1 and 3 vs. bars 2 and 4) did not differ for those low in enemy fear, $t = 1.06$, $p = .29$.

Sunscreen intentions.—Submitting sunscreen intentions to the same regression analysis revealed that Enemy fear was generally associated with higher sunscreen intentions in all three steps (at Step 3, β =.51, $SE = .15$, $t(166) = 3.40$, $p < .001$). All other main and two-way interaction effects were not significant (ts < 1.14, ps > .25). Step 3 yielded a three-way interaction that accounted for a significant proportion of the total variance, β =.35, $SE = .15$, $t(166) = 2.31$, $p = .02$, $\Delta R^2 = .03$ (Figure 11). For participants high in enemy fear, framing UV risk metaphorically induced lower intentions when paired with the mismatching, literal message about sun protection than when paired with the matching, metaphoric message about sun protection (slope connecting bars 5 and 7). Similarly, framing UV risk in literal terms induced lower intentions when paired with the metaphoric protection message than when paired with the literal protection message for these participants (slope connecting bars 8 and 6). This difference in slopes held for participants high in enemy fear ($t = 2.26$, $p = .03$) but not for the comparable slopes for those low in enemy fear (connecting bars 1 and 3 vs. bars 2 and 4; $t = 1.12$, $p = .27$).

Willingness to pay for sunscreen.—The regression analyses of willingness to pay for sunscreen yielded non-significant main and two-way interaction effects for Enemy fear, Risk framing, or Response framing in all three steps (t's < 1.67, p's > .10). Step 3 revealed a three-way interaction that accounted for a significant increment in the total variance explained, β =.81, $SE = .29$, $t(166) = 2.81$, $p = .006$, $\Delta R^2 = .04$. The patterns of estimated means (Figure 12) support the integration of the source resonance and response-matching hypotheses. For participants high in enemy fear, those who read the metaphorically-framed risk message were willing to pay less for sunscreen when the sun protection message was framed literally than when it was framed in metaphorical terms (slope connecting bars 5 and 7). Similarly, the amount those who read the literal risk message were willing to pay for sunscreen was lower when they read the mismatched, metaphoric protection message than when they read the matched, literal protection message (bars 6 to 8). While this difference in slopes held for participants high in enemy fear ($t = 2.79$. $p = .006$) it did not hold for the comparable slopes for participants low in enemy fear (bars 1 to 3 vs. bars 4 to 2; $t = 1.32$, $p = .19$).

Mediation.—We used the same mediational analyses described earlier to test whether conditional worry about skin cancer mediated the interactive effects of enemy fear, risk framing, and protection framing on sunscreen intentions and willingness to pay for sunscreen (both presented in Figure 13). Each analysis tested the three-way interaction term as the predictor and conditional worry as the mediator, with the main effects and two-way interaction terms as covariates.

For sunscreen intentions, the model revealed a significant indirect effect of the Enemy fear × Risk framing × Protection framing interaction on sunscreen intentions through worry; 95% CI = [.03, .33]. Further, the direct effect of the interaction on sunscreen intentions was not statistically significant, 95% CI = [−.07, .46]. For willingness to pay for sunscreen, the model yielded a significant direct effect of the three-way interaction, 95% CI = [.04, 1.14], and a significant indirect effect of the three-way interaction through worry; 95% CI = [.04, .50].

Study 3 offers several contributions. The results support the integrative hypothesis that conditional worry mediates the message framing effects on protection intentions when enemy fear is high but not when enemy fear is low. When the message presented a mismatch between metaphors for risk and prevention – either when framing UV risk metaphorically as an enemy combatant but following with a literal description of sunscreen, or when presenting UV risk in literal terms but following with sun protection as a team of superheroes, recipients high in enemy fear were less worried about their skin cancer risk and, in turn, less motivated to apply sunscreen and less willing to pay higher prices for sunscreen. Yet congruence in metaphoric or literal framing elicited an energizing level of worry. For participants low in enemy fear, however, the metaphoric risk message and metaphoric protection message did not influence worry, sunscreen intentions, or willingness to pay for sunscreen.

General Discussion

The theoretical goal of the current research was to deepen understanding of how metaphor shapes thinking and thus how it can both facilitate and undermine productive reasoning about abstract problems. The complementary practical goal was to advance the study of metaphor in health communication by modeling factors that mediate and moderate the productivity of metaphoric health messages.

As background, effective health messages elicit an energizing level of worry about a health risk and convince recipients that the recommended prevention response is suited to reduce that risk (Peters et al., 2013). Metaphor has the potential to enhance the motivational capacity of communications in these ways. Health communicators' intuitions of this possibility likely lie behind their frequent use of metaphors to represent health-related concepts. But might there be downsides to the approach, and if so, what factors influence when those downsides emerge?

Building from CMT's insight that metaphoric messages prompt recipients to transfer knowledge of the metaphor's source to interpret and evaluate its target, the current studies tested *source resonance* and *metaphoric fit* hypotheses in the context of skin cancer messaging. This is important because although people engage in sun protection when they are sufficiently worried (Kiviniemi & Ellis, 2014), part of the problem is that quite often they are not (Hay et al., 2005). They may also fail to see how recommended sun-safe behaviors work to lower their risk.

Study 1 showed that for individuals who strongly fear enemy confrontation, exposure to metaphoric phrases and imagery comparing UV radiation to an aggressive sun pummeling their skin increased worry about skin cancer risk, and through this elevated worry, strengthened intentions to use sun protection. But among participants who reported low enemy fear, this metaphor had the opposite effect of inducing lower levels of worry and protection intentions. Study 3 provided a conceptual replication. These studies provide the first evidence that metaphoric messages can interact with variability in the source's emotional resonance as distinct from relatively "cool" knowledge about the source (e.g., beliefs about its salient properties).

In Studies 2 and 3, participants felt less worry about their cancer risk without sunscreen, which in turn predicted lower intentions to use sun protection, if they were presented with mismatched framings (i.e., metaphoric-literal; literal-metaphoric) compared to matched framings (i.e., metaphoric-metaphoric; literal-literal).

The present findings emerged across three different samples and settings—online MTurk workers (Study 1), undergraduates in the laboratory (Study 2), and community members recreating outdoors (Study 3)—and with diversified messages and measures. Such convergence bolsters confidence in the effects' robustness and, at a practical level, recommends the strategic inclusion of metaphors in health communication campaigns. Although these studies do not show effects on overt behavior, the willingness-to-pay measure used in Study 3 gets closer to that goal, and the literature substantiates that intentions are crucial precursors of behavioral engagement (Sheeran, Conner, & Norman, 2001). An extension to overt behavior remains an important task for future research, but taken together, the present findings lay a promising foundation that offers both applied and conceptual insights.

Contribution to Health Communication Research

The current work points to metaphor use as a potential communication strategy for achieving oft-noted health-communication goals of increasing emotional potency and prevention relevance (e.g., Peters et al., 2013; Witte & Allen, 2000). Yet it is a strategy that carries with it notable risk if not used with an overarching appreciation of relations between risk construal, prevention construal, and audience resonance.

This in turn provides a fuller understanding of the psychological processes underlying mental models of health risks and prevention. Mainstream perspectives in health communication assume that people generally base their emotions and cognitions about a risk on knowledge structures with a relatively obvious bearing on the risk itself (Becker, 1974; Glanz et al., 2002). People's models of skin cancer risk, for example, are assumed to be based on their accumulated knowledge about skin cancer (Cameron, 2008). Despite its intuitive appeal and ample empirical support, this account may be incomplete. Metaphor research, and the current findings in particular, offer the complementary insight that mental models of abstract ideas can be systematically structured by personalized representations of superficially unrelated ideas.

In addition, the present research augments qualitative studies of metaphor use in cancer discourse. With few exceptions, this work has focused on metaphor's role in messages about cancer diagnoses, treatment, and recovery (Casarett et al., 2010; Park et al., 2009). What little extant research connects metaphor use to prevention behavior has been mostly descriptive and has not assessed its impact by manipulating metaphor exposure (Downs et al., 2009). The current evidence that metaphoric messages impact prevention-related emotions and intentions shows that metaphors matter with regards to prevention, and adds to the growing body of experimental research showing that metaphor has a causal impact on mental cancer models and behavior (e.g., Hauser & Schwarz, 2015).

At the same time, it is important to consider how qualitative work informs directions for future experimental inquiry. A major takeaway of qualitative analyses is that metaphors in cancer discourse can be counterproductive (Mukherjee, 2011; Sontag, 1978). Why this is the case is made clear by a central tenet of CMT and illuminated by the present studies. The theory holds that a metaphor creates a *partial* mapping, highlighting select aspects of the target concept (making them salient guides to thought and behavior) while playing down other aspects of the relevant ideas, pushing them to the periphery of consciousness (Kövecses, 2010). By basing models of a health concept on concepts of a different kind without due consideration of the health concept's unique properties, metaphors can perpetuate counterproductive beliefs about health risks and the importance of a given prevention behavior.

Among the more notable findings of the present research is that matching metaphor messages did not produce more worry or stronger intentions than matching literal messages. Some plausible explanations are: brief messages yield minimal benefit; different metaphors produce stronger effects; matching literal framings for risk and prevention are sufficiently comprehensible and effective, as predicted by other models (e.g., Witte & Allen, 2000). Nonetheless, the present research fires a proverbial warning shot across the bow for metaphoric (health) research by revealing conditions when metaphor can backfire. Caution tempered with contextual knowledge is warranted when considering using metaphors in health messages.

Future Directions of Health-Oriented Metaphor Research

A practical problem—as evidenced by self-defeating health decisions—provides an invitation for basic theory to be enriched by evaluating how conceptual dynamics unfold in the life problems we routinely encounter (Lewin, 1951; Rothman & Salovey, 2007). The present context of unprotected UV exposure accepts that invitation.

Although growing research has demonstrated metaphoric influences on attitudes, reasoning, and behavior across various domains (Landau, 2017), relatively less is known about the extent to which metaphoric transfer varies across individuals. This is starting to change. Recent research shows that certain individuals are more prone to metaphoric thinking (Fetterman et al., 2016). Such insights are important, but do not address when particular metaphors will persuade particular individuals. Some prior work has tested how metaphoric framing effects are moderated by individual differences in source knowledge (Landau, Keefer et al. 2014; Ottati et al., 1999). The current studies go further to show that metaphors

can transfer not only “cold” perceptions of the source, but also “hot” emotional associations. In all three studies, to the extent that the metaphoric message influenced worry, it influenced intentions. These findings thus highlight emotion as an important mechanism to consider in future metaphor research.

Future studies could further probe the moderating role of differences in not just receptivity to particular metaphors, but in the triggered perceptions of efficacy as well. To illustrate, comparing health check-ups to getting a regular oil change for your car may work quite well for car enthusiasts attuned to the hum of an engine. But for others who get an oil change only when they happen to glance at the little sticker in their car window, this metaphor would fall flat and potentially trivialize the intended behavior (“After all, my car seems to run fine even when I forget to change the oil”). That is, the knowledge that is presumably transferred discourages, rather than encourages, the behavior. Such a metaphor might also weaken perceptions of *self*-efficacy. If the metaphor prompts the audience to question their ability (“Geez, I’m not sure where the oil goes”), then it is unlikely to foster the sense that one can execute the recommended behavior. Given the important role of self-efficacy in health behavior change (Sheeran, Harris, & Epton, 2014), this is an important direction for future inquiry.

Finally, the present studies extend theory on metaphoric fit outlined in previous work (Hauser & Schwarz, 2015; Keefer et al., 2014). It supports the claim that a metaphor intended to energize perceptions of risk can hamper such perceptions when juxtaposed with a mismatching literal prevention message. Future research might conceptualize this issue in terms of construal, and thus invite integration with literatures that have not previously been considered alongside metaphor research. Consider, for example, research inspired by regulatory focus theory, prospect theory, and other perspectives highlighting the importance of matching messages with key features of the individual, problem, and solution (Cesario et al., 2004; Updegraff & Rothman, 2013). Metaphors can interface with each element of this equation. For example, if a smoker construes quitting in prevention terms (e.g., reducing risk for lung cancer), and they are presented with a promotion-focused metaphor of moving “forward” toward being smoke-free, the metaphor may not work and even backfire. In contrast, a prevention-focused metaphor would match their regulatory orientation and create a regulatory fit. This is just one example of the generative lines of inquiry awaiting further research.

Conclusion

Despite decades of research, social scientists continue to grapple with the problem of crafting persuasion messages that enable recipients to grasp complex, even mysterious ideas about health. Metaphors can help by providing concrete construals that make salient the need for urgent action. But they can also hurt. CMT provides novel insights into the mechanics of metaphor, explaining how it persuades by transferring schematic knowledge, emotions, and problem-solving heuristics from one thing to something else. At the same time, it is precisely by virtue of these mechanisms that metaphors can fall flat or, worse, backfire and undermine motivation to engage in recommended behaviors. Metaphors must be chosen wisely based on theoretically-informed considerations of how message recipients

think and feel about the metaphor's source, and how these thoughts and feelings will guide their behavior.

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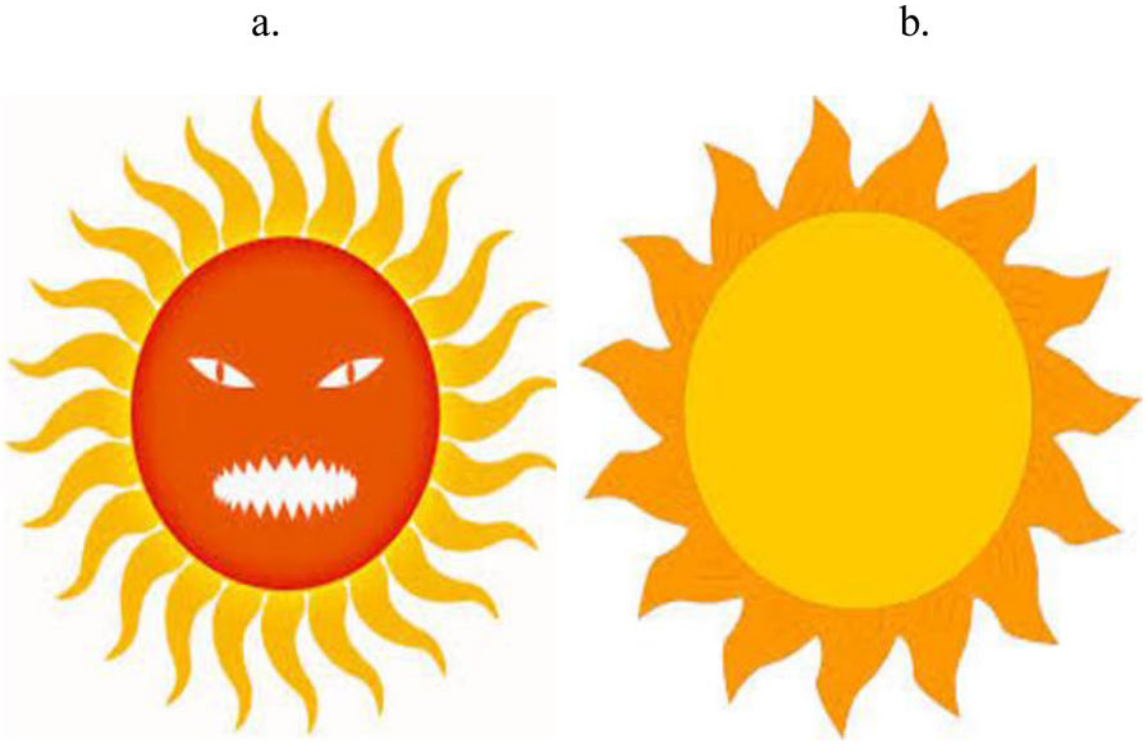

Figure 1.
Images used in in the Risk Framing Manipulation in Studies 1 and 2: Enemy-Metaphoric Sun (left) and Literal Sun (right).

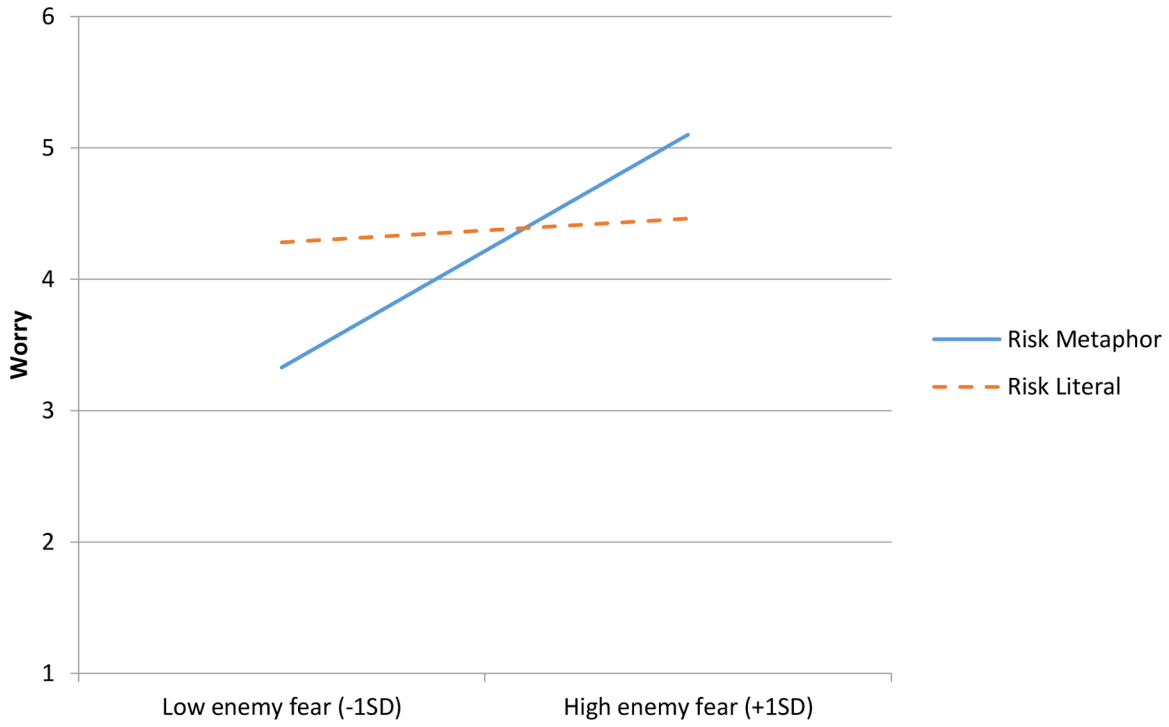

Figure 2.
Skin Cancer Worry as a Function of Trait Enemy Fear and Risk Framing Condition (Study 1).

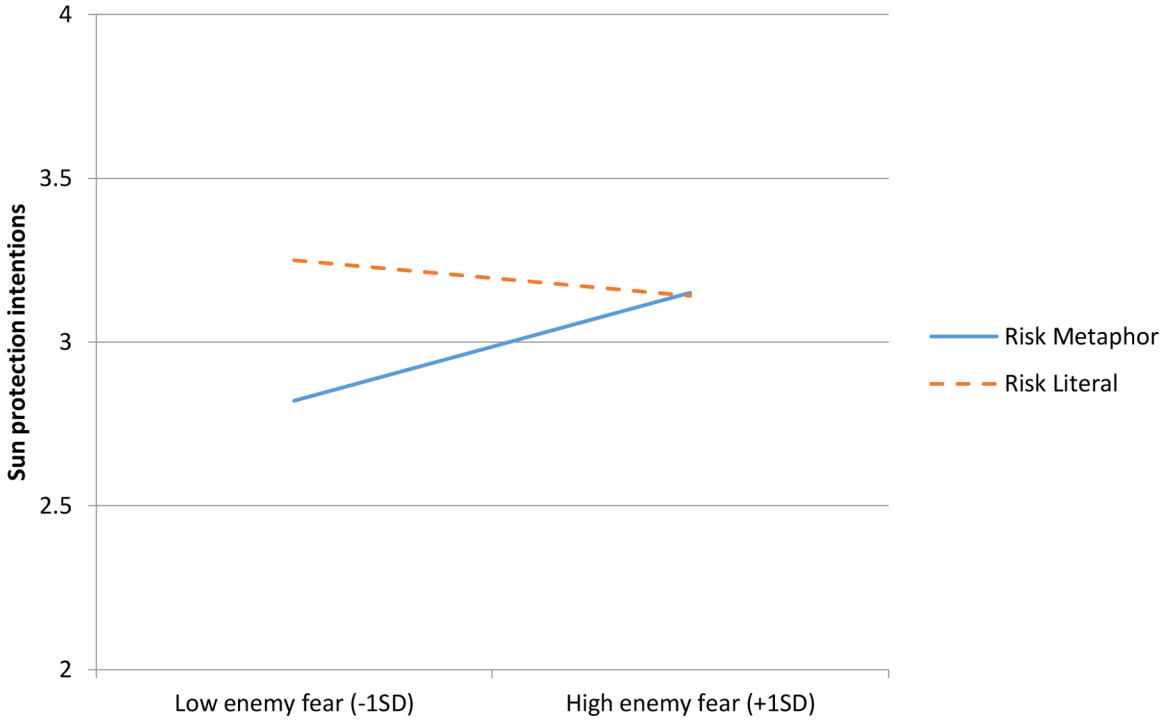

Figure 3.
Sun Protection Intentions as a Function of Trait Enemy Fear and Risk Framing Condition (Study 1).

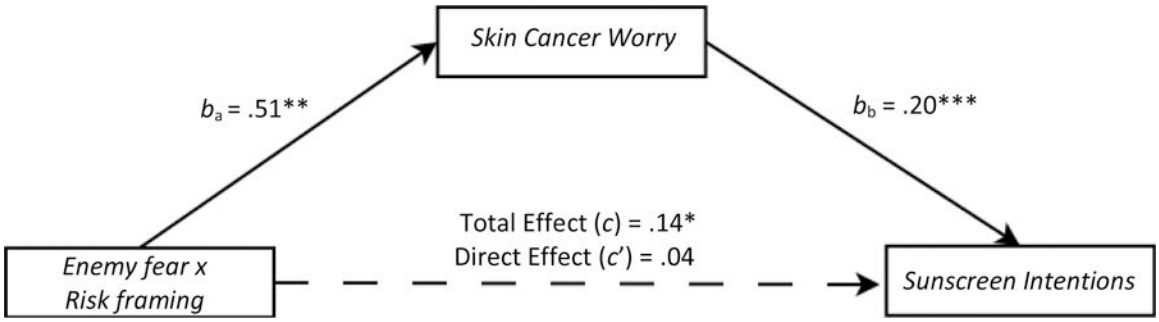

Figure 4.

Mediation Analyses: Skin Cancer Worry Mediates the Effect of Message Type and Audience Characteristics on Prevention Engagement (Study 1).

Unstandardized indirect effect with 5,000 bootstrapped resamples = .10, SE = .04, 95% CI = [.05, .19]. Total adjusted R^2 for the model = .21, $F(4, 164) = 10.69$, $p < .001$.

Figure 5.
Images used in in the Response Framing Manipulation in Study 2: Armor-Metaphoric Sunscreen (left) and Literal Sunscreen (right).

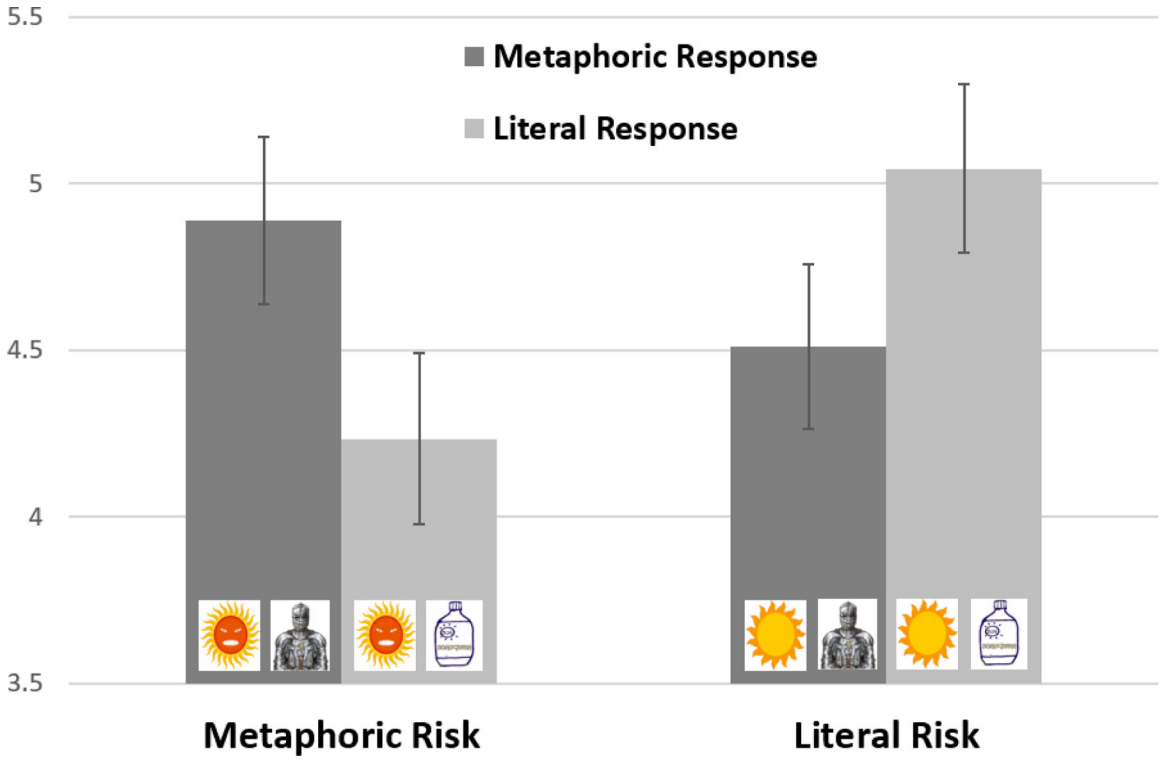

Figure 6.
Conditional Skin Cancer Worry by Risk Framing and Response Framing Conditions (Study 2).

Note: Single-item measure of skin cancer worry on a 7-point scale. Error bars represent +/−1 SE.

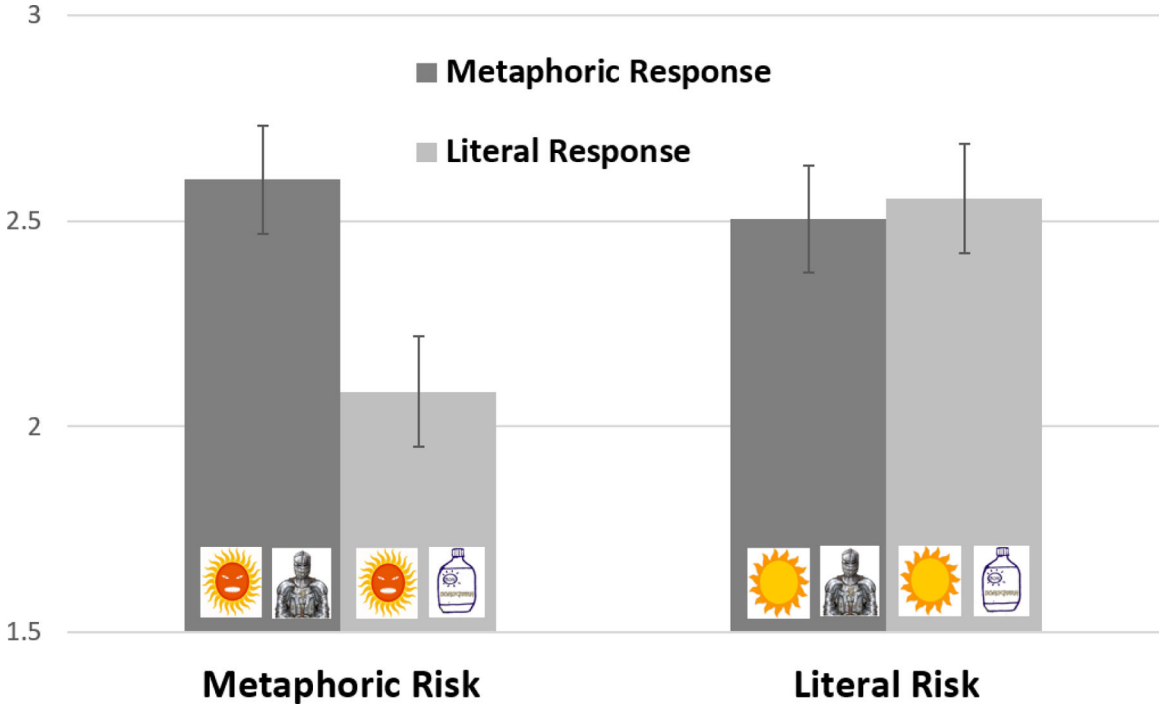

Figure 7.

Sunscreen Intentions by Risk Framing and Response Framing Conditions (Study 2).

Note: Three items, each on a 5-point scale, were averaged to create a composite score reflecting intentions to use sunscreen (α = .83). Error bars represent +/−1 SE.

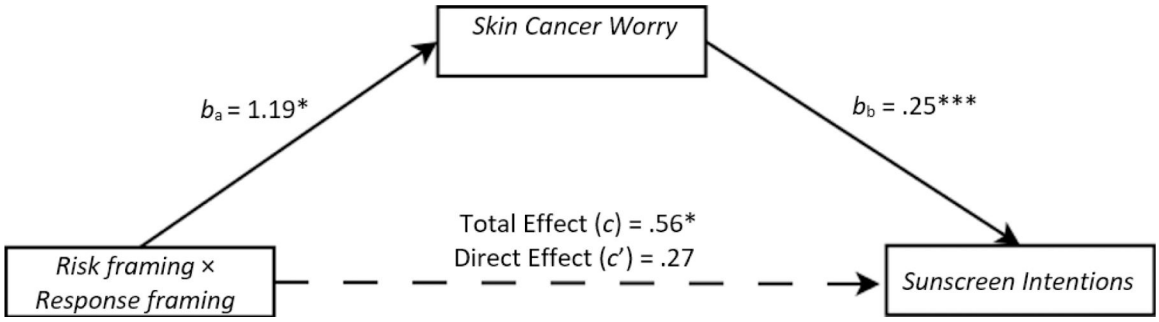

Figure 8.

Mediation Analysis (Study 2).

Unstandardized indirect effect with 5,000 bootstrapped resamples = .29, SE = .13, 95% CI = [.05, .58]. Total adjusted R^2 for the model = .26, $F(4, 174) = 15.05$, $p < .001$.

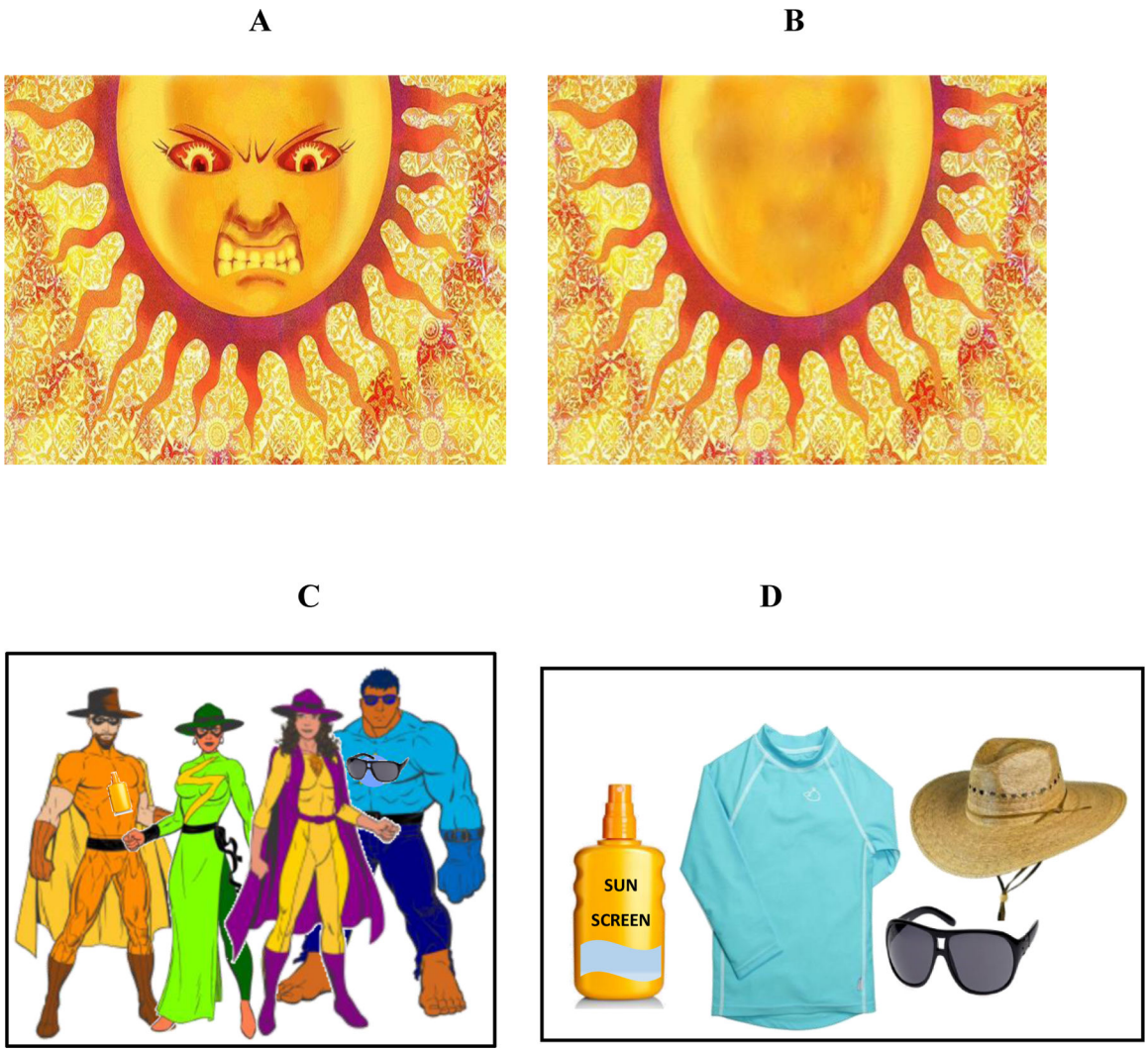

Figure 9.
Images used in Study 3 for the Risk Framing Conditions (A: Enemy-Metaphoric Sun and B: Literal Sun) and Response Framing Conditions (C: Superheroes and D: Sun Protection Products).

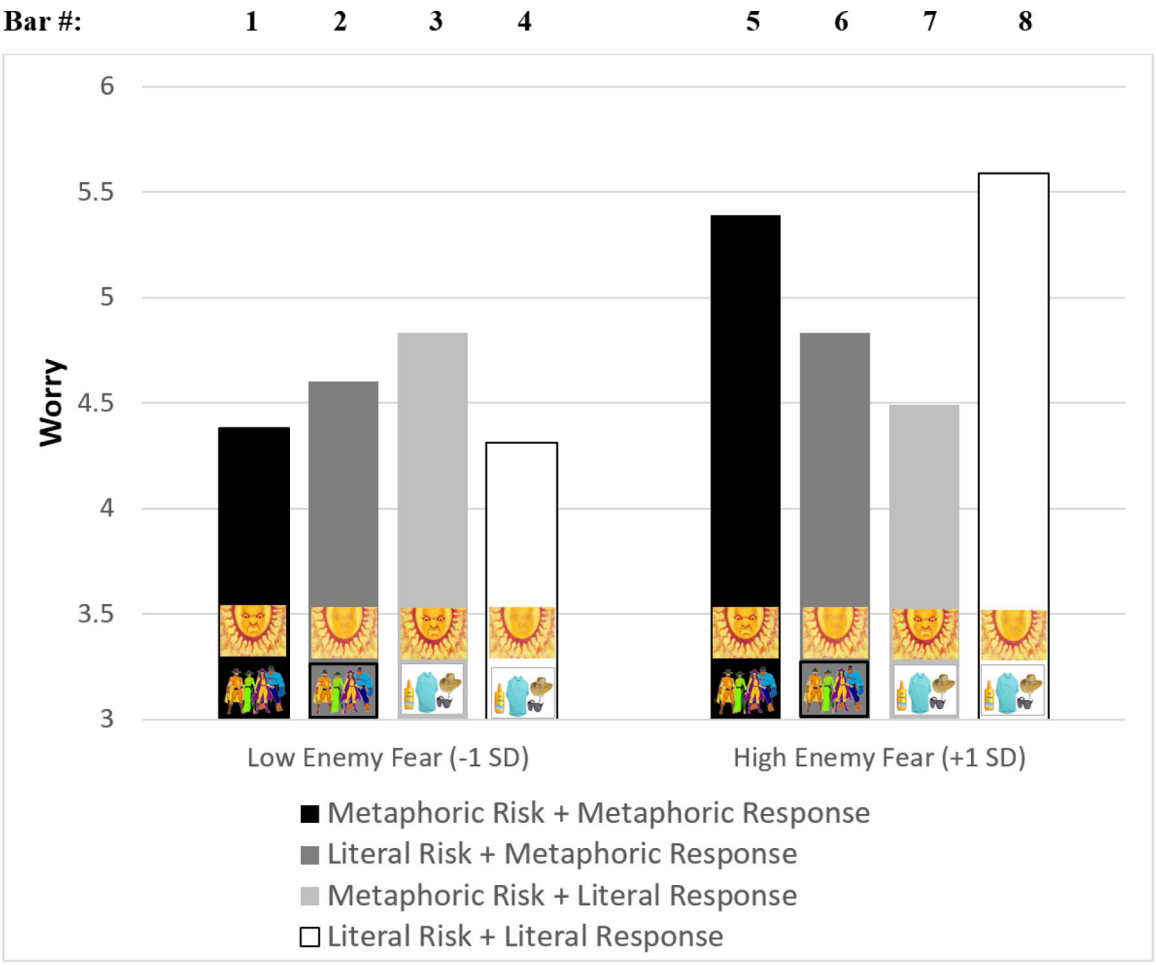

Figure 10.
Enemy Fear Moderates the Effects of UV Risk Framing and Sun Protection Framing on Conditional *Skin Cancer Worry* (Study 3).

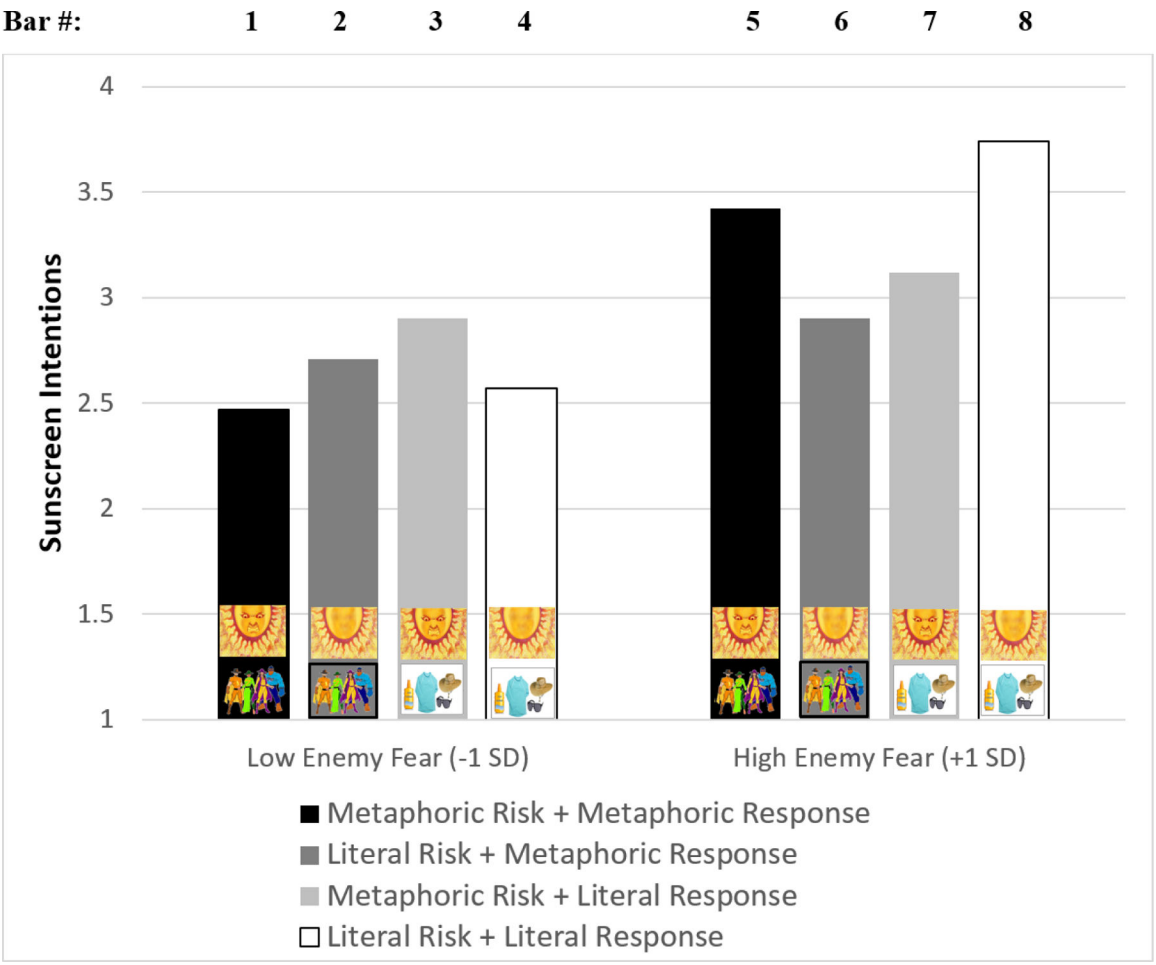

Figure 11.
Enemy Fear Moderates the Effects of UV Risk Framing and Sun Protection Framing on *Sunscreen Intentions* (Study 3).

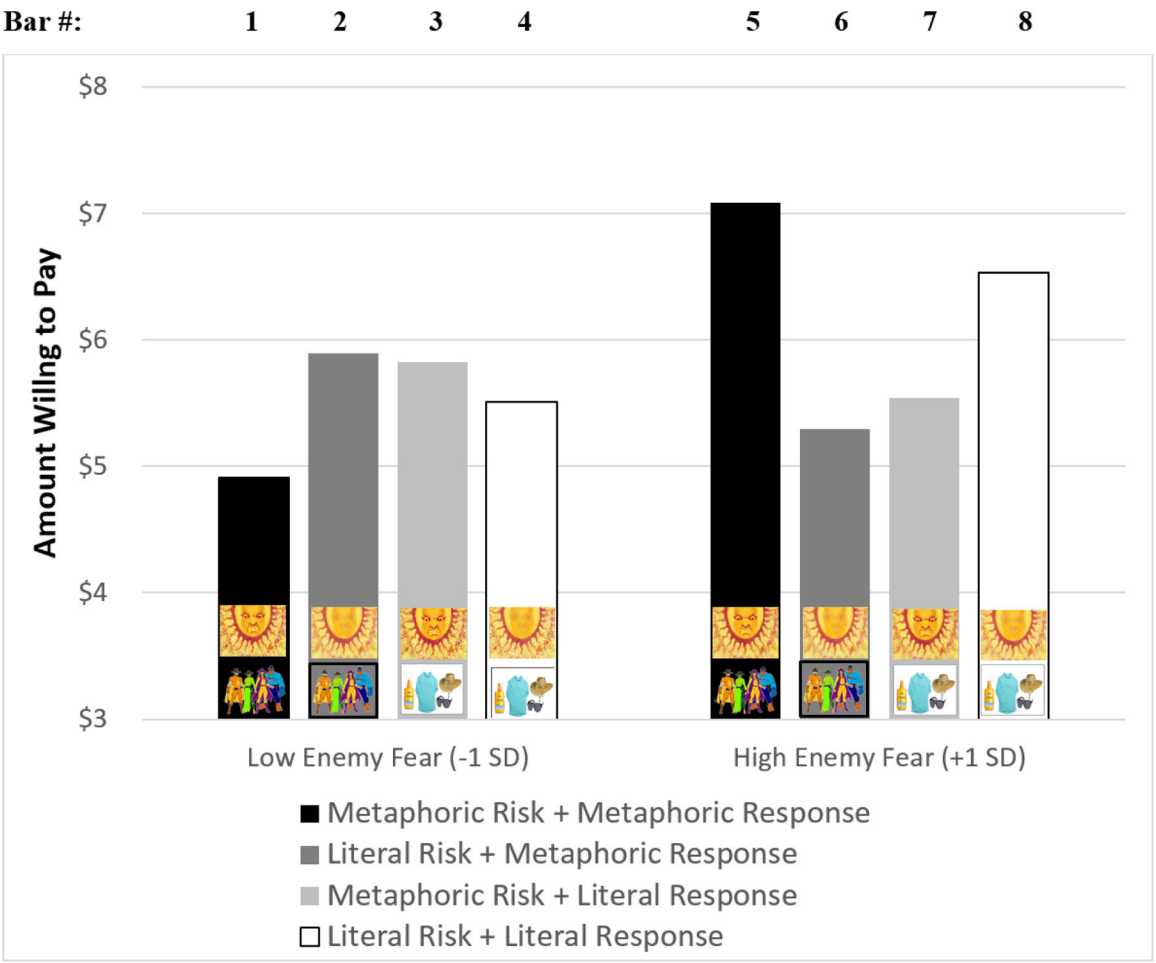

Figure 12.
Enemy Fear Moderates the Effects of UV Risk Framing and Sun Protection Framing on *Willingness to Pay for Sunscreen* (Study 3).

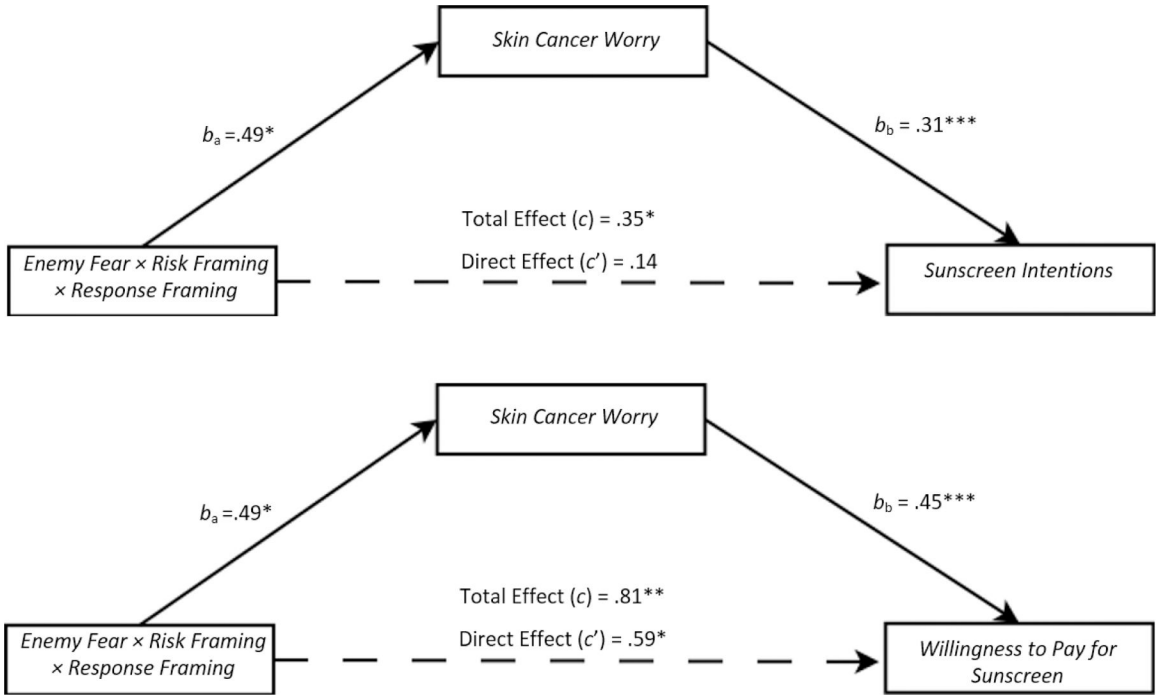

Figure 13.

Mediation Analyses (Study 3)

Unstandardized indirect effect through skin cancer worry (with 5,000 bootstrapped resamples) = .15, SE = .12, 95% CI = [.03, .33]. Model R^2 = .29, F(8, 165) = 8.31, p < .001.

Unstandardized indirect effect through skin cancer worry (with 5,000 bootstrapped resamples) = .22, SE = .12, 95% CI = [.04, .50]. Model R^2 = .17, F(8, 165) = 4.25, p < .001.

Note: For all analyses, values represent unstandardized regression coefficients. The main and two-way interaction effects of Risk Framing, Response Framing and Enemy Fear (in Studies 1 and 3) are included as covariates within the model. *p < .05. **p < .01. ***p < .001.

Table 1

Bivariate correlations between continuous variables in Study 1.

Variables	1	2	3	4
1. Enemy fear	--			
2. Vehicle fear	.50**	--		
3. Skin cancer worry	.29**	.37**	--	
4. Sun protection intentions	.05	.02	.43**	

** $p < .01$

Table 2

Bivariate correlations between continuous variables in Study 3.

Variables	1	2	3	4
1. Enemy fear	--			
2. Skin cancer worry	.18*	--		
3. Sun protection intentions	26**	.49**	--	
4. Willingness to pay	.12	.36**	.34**	--

*$p < .05$

**$p < .01$