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DANGER! NO HIKING! Risky Hiking Decisions, Framing of Normative Warning Messages, and Self-Exempting Beliefs

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Abstract

Natural resource managers are often dismayed that visitors disobey warning signs, which can contribute to accidents and injuries. This study examined whether normative content within signs as well as internal beliefs of the hiker predicted responses to warning messages. College students ($N = 198$) with recent hiking experience read four hypothetical risky hiking scenarios (e.g., getting too close to a cliff edge or bison) and were shown warning signs that varied norm type (injunctive versus descriptive) and framing (positive versus negative). Participants rated likelihood to hike and get hurt, and responded to scales measuring self-exempting beliefs and risk attitudes. Signs with descriptive norms and negative framing were most effective. Self-exempting beliefs were better predictors of likelihood to hike and get hurt ratings than risk attitudes. Results suggest that visitor safety might be enhanced by framing warning messages to include descriptive normative information and to target self-exempting beliefs.

Keywords: Risk perception, outdoor recreation, safety, social norms, self-exempting beliefs

Management Implications

This study offers outdoor recreation managers insight into why hikers might disobey warning signs regarding safety and how to make such warning signs more effective.

1. Providing information about past hiker injuries that resulted from disobeying warning information may be more effective at reducing risky hiking than instructing hikers not to do something because they *could* get hurt.
2. Hikers who report a willingness to disregard safety warnings are more likely to hold certain self-exempting beliefs (i.e., believing the risks are exaggerated, believing they can prevent an accident, believing the benefits outweigh the risks). Understanding these beliefs and designing warning messages that deliberately attempt to reduce these beliefs could potentially help prevent hiking accidents.

DANGER! NO HIKING! Risky Hiking Decisions, Framing of Normative Warning Messages, and Self-Exempting Beliefs

Outdoor recreation in nature promotes health and psychological well-being (Romagosa et al., 2015; Thomsen et al., 2018), but it can also pose risks. In 2017, the U.S. National Parks Service reported 4,194 search and rescue (SAR) operations, an average of 11.5 a day. One review found that 48% of SAR incidents in U.S. National Parks involved hiking (Heggie & Amundson, 2009). One factor contributing to such outdoor recreation accidents may be the failure of hikers to adhere to warning signs (Associated Press, 2016; Heggie & Heggie, 2004; Yellowstone National Park, 2016). A recent review showed that outdoor researchers recommend compliance with warning signs as an important way of preventing hiking accidents and incidents (Kortenkamp et al., 2017).

Hikers may disobey warning signs for a number of reasons. Laughery and Wogalter (2014) provided an overview of research on warning signs and summarized a commonly applied model which proposes two broad categories of influences on warning effectiveness: design factors and non-design factors. Design factors concern characteristics of the warning message itself (content, color, size, location, etc.). Non-design factors include characteristics of the target audience or the situation in which the warning is encountered. Laughery and Wogalter (2014) noted that the empirical research has focused more on the design factors, yet non-design factors can sometimes be more instrumental.

The current project contributes to this body of research by examining both design and non-design factors that might influence hikers' compliance with warning signs. Specifically, the current study examined the effectiveness of normative messages on warning signs (design factors) as well as hiker's self-exempting beliefs about hiking risks (non-design factors). The

context of our study was hiking risks encountered in natural areas, such as state or national parks and forests. A recent review noted that there is little empirical research on safety messaging in the context of natural areas (Saunders et al., 2019). We focused on simple hiking risks, rather than extreme outdoor sports, because many rescue incidents in U.S. National Parks occur during hiking, as mentioned previously.

Normative Warning Messages

Several previous studies have examined warning sign attention and compliance, testing the effectiveness of different messages, although mostly in the context of natural resource protection (Ballantyne & Hughes, 2006; Bradford & McIntyre, 2007; Cialdini et al., 2006; Girasek, 2019; Hall et al., 2010; Hockett & Hall, 2007; Johnson & Swearingen, 1992; Marschall et al., 2017; Park et al., 2008; Reiner & Lawson, 2009; Schwartz, et al., 2018; Winter, 2006). A variety of theoretical perspectives are represented in these studies. We chose to focus on normative messages because they are common to several theories of attitude-behavior relations, for example, Ajzen's (1991) Theory of Planned Behavior. Normative messages have also been shown to influence risky behaviors and behavioral intentions, such as drinking alcohol, cannabis use, using sun protection, and sexual aggression (Blevins et al., 2018; Lewis & Neighbors, 2006; Prince & Carey, 2010; Reid & Aiken, 2013; Zounlome & Wong, 2019). Therefore, normative messages may also impact the risky hiking behavioral intentions focused on in the present study.

Cialdini and Trost (1998) made an important distinction between descriptive and injunctive norms which we use in this study. Descriptive norms are beliefs about what most people do in a situation, while injunctive norms are beliefs about the social approval or disapproval of the behavior in question. Many research studies have looked at descriptive and/or injunctive norms as predictors of risky health behaviors, such as drinking or smoking. Several

meta-analyses have found evidence that both types of norms predict such risky behaviors, but descriptive norms are more predictive of health-risk behaviors than injunctive norms (East et al., 2021; Manning, 2009; McEachan et al., 2016; van de Bongardt, 2015). However, there is also evidence that injunctive norms are stronger predictors of behavioral intentions (Manning, 2009; McEachan et al., 2016). Since the present study measured risky hiking behavioral intentions, these results suggest that the injunctive norms may be more effective than the descriptive norms. However, the previous meta-analyses included only correlational studies and did not examine experimental manipulations of normative messages as the current study does.

Several studies have examined the effectiveness of interventions using normative information in the context of health risks, most focusing on alcohol use (Reid et al., 2010). Many of these studies have applied Social Norms Theory (Perkins & Berkowitz, 1986), in which normative information is used to counteract misperceptions about the prevalence and acceptance of a risky behavior, such as binge drinking or drug use (see Demsey et al., 2018, for a critical review of such studies). Only a few intervention studies have compared the efficacy of descriptive to injunctive normative messages in the context of risky health behaviors (Mahler et al., 2008; Mollen et al., 2013; Patel, 2011; Prince et al. 2015; Smith et al., 2018). The results of these studies are mixed. Patel (2011) found no effects of either descriptive or injunctive normative messages. Prince et al. (2015) found that injunctive norms were effective, but descriptive norms were not. However, Smith et al.'s (2018) results were the opposite. Finally, both descriptive and injunctive normative messages were equally effective in two studies (Mahler et al., 2008; Mollen et al., 2013). In sum, the results from studies of normative message interventions in the context of risky health behaviors show no clear pattern of one type of norm being more influential than the other. However, to our knowledge no studies have examined

normative messaging in the context of outdoor recreation risks. The current study will compare the effectiveness of both descriptive and injunctive norms in risky hiking situations.

A related body of research has examined the effectiveness of both types of norms in messages promoting environmentally sustainable behavior (Cialdini, 2003; Newell et al., 2014; Poškus, 2016), and a few studies have looked specifically at hiking behavior (Cialdini et al., 2006; Riske, 2018; Winter, 2006). Cialdini et al. (2006) used both descriptive and injunctive norms and positive and negative framing in a study of how to deter visitors from removing petrified wood from the U.S. Petrified Forest National Park. The results showed that the negatively worded injunctive norm (an image of a hand taking wood with a red circle and bar superimposed on it and the words, "Please don't remove petrified wood from the park") led to the greatest compliance whereas the negatively worded descriptive norm (an image of three visitors taking wood along with the words "Many past visitors have removed the petrified wood from the park, changing the state of the Petrified Forest'') led to the lowest levels of compliance. Similarly, Winter (2006) tested the same four normative messages on signs directing hikers to stay on trails and again found the most effective message used a negatively worded injunctive norm. The current study examined the same four types of normative messages used by Cialdini et al. (2006) and Winter (2006), manipulating the type of norm (injunctive vs. descriptive) and the framing (positive vs. negative). However, rather than focusing on hiking behavior that damages natural resources, the normative messages in the present study focused on hiking behavior that is dangerous, with the expectation that these messages might have similar effects.

Research Goal 1

The current study breaks new ground by testing how norm type and framing influence the effectiveness of warning signs focused on the personal safety of the hiker. Given there was no

clear pattern of descriptive or injunctive normative message interventions being more effective in the previous research on risky health behaviors, we based a hypothesis on Cialdini et al. (2006) and Winter (2006). We hypothesized that the negatively framed injunctive normative message would be the most effective.

Self-Exempting Beliefs

The second aspect of this study focused on internal characteristics of the hiker that contribute to ignoring warning information about safety risks. Past research on outdoor recreation risks has focused primarily on extreme sports (e.g., rock climbing, skydiving, white water kayaking). These studies have identified personality characteristics that predict participation in high-risk outdoor sports, such as sensation seeking, impulsivity, extraversion, autonomy, and self-efficacy (e.g., Llewellyn et al., 2008; McEwan et al., 2019; Robinson, 1992). Although important in itself, that research does not necessarily help explain the risky behaviors of the majority of outdoor recreation participants who are not engaged in extreme sports. The present study focused on hiking, which may not be considered risky by the general public but nonetheless can pose significant risks depending on the situation and conditions (Haegeli & Pröbstl-Haider, 2016). The current study used risky hiking situations such as approaching a cliff edge or bison to examine individual differences in responses to safety warnings.

Some research has explored characteristics and beliefs of hikers and beach visitors who ignore safety warning information, and intriguing findings suggest certain beliefs are associated with warning sign violations. Aucote et al. (2010) found that many people walking on the beach doubted the seriousness of warning signs about rocks falling from a cliff face, and those who said they had ignored the warning signs believed the risk was lower than those who obeyed the signs. In another study of beach visitors, Gstaettner et al. (2017) interviewed those who ignored

warning signs about walking across a sandbar to an island and found many believed the benefits outweighed the risks and any possible negative outcomes applied to others but not themselves. Similarly, Girasek et al. (2016a) surveyed hikers who went beyond warning signs into risk zones in the water. Almost all of the hikers who went into the risk zones reported feeling safe, yet many thought other hikers should not go there because it was dangerous, or should only go there if they were careful, skilled, and knew their limits. This suggests that the hikers were believing themselves to be exempt from the dangers. Hikers also said they should be allowed to go there because it provided a positive experience or benefit, and some reported that it was no more dangerous than other activities or park locations.

The beliefs and justifications provided by hikers and beach visitors in these studies correspond with a set of self-exempting beliefs identified by Oakes et al.(2004) in a study about how smokers justify their habit in the face of safety warnings. Oakes et al. (2004) developed a scale to measure these beliefs and identified four categories:

1) Skeptic beliefs: believing the extent of the risk is exaggerated.

2) Bulletproof beliefs: believing one is immune to the negative effects of the activity.

3) Worth it beliefs: believing the benefits outweigh the risks.

4) Jungle beliefs: normalizing the risks because everything is dangerous.

Oakes et al. (2004) found that smokers were more likely to endorse these beliefs than recent quitters, indicating that these self-exempting beliefs are related to decisions to participate in risky activities. The current study will extend this research to explore the connection between self-exempting beliefs and risky hiking behavioral intentions.

Research Goal 2

The second goal of this study was to investigate the four types of self-exempting beliefs within the context of a hypothetical risky hiking scenario. Based on the work of Oakes et al. (2004), we hypothesized that endorsement of these beliefs would predict greater intentions to undertake hiking risks and lower perceptions of the likelihood of injury when faced with warning sign information.

Method

Participants

Participants in this study were college students (N = 198) in the United States who self-reported that they had gone hiking in a natural area (e.g., forest, marsh) in the past year. We also considered walking to and from hunting, fishing, and climbing sites as hiking if it was in a natural area. The vast majority (84%) reported having a moderate to a lot of outdoor experience in natural settings. The majority of participants were female (58%; 41% male; 1% missing/preferred not to answer) and white (93%; 5% reported Asian; 3% reported Hispanic/Latinx; 1% or less of other races/ethnicities were reported). The mean age was 19.14 (SD = 1.24). Participants were recruited through the psychology participant pool, which includes students of all majors who are taking lower level psychology classes. The participants received extra credit in their psychology courses for completing this study.

Materials and Procedures

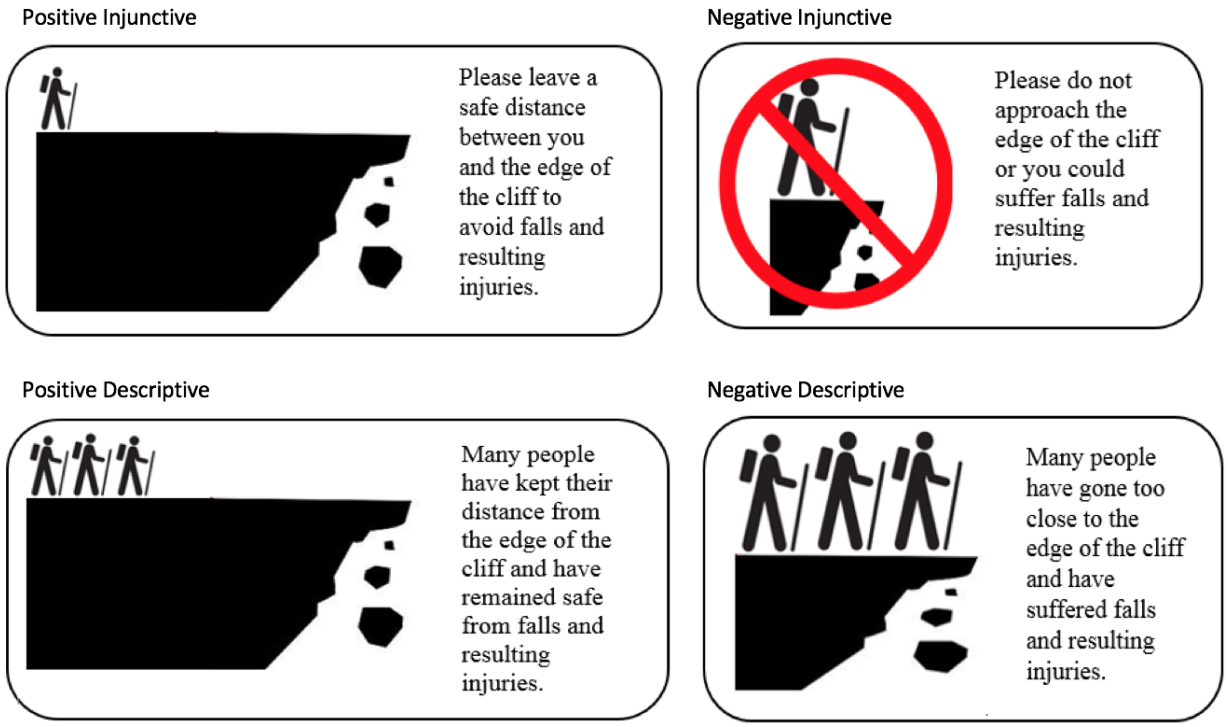
The study was administered using the Qualtrics web-based survey platform. Participants completed the online study on their own. After giving consent, they answered a screening question about hiking experiences in the past year. Then, they were presented with four hiking scenarios that described different risky situations: falling rock, approaching bison, going too

close to a cliff edge, and hiking in a lightning storm. These four scenarios were chosen by the research team to represent a variety of common hiking risk situations based on reviewed research on hiking risk prevention (Kortenkamp et al., 2017), news accounts of hiking accidents and injuries, and personal experiences. The scenarios were always presented in this order and each scenario had one accompanying photograph of a trail in a natural setting. Participants were told to imagine they were the hiker in the story. After reading each scenario, participants were shown one of four warning signs that were designed to manipulate the norm type (injunctive vs. descriptive) and framing (positive vs. negative) of the message. The order in which the signs were presented was counterbalanced using a Latin square design balanced to control for first-order carryover effects, also called a "Williams design" (Williams, 1949, 1950; see also StatPages, n.d.). We used the randomizer tool in Qualtrics to assign participants to one of the four sign orders. Thus each participant saw all four types of signs in a counterbalanced order, and each scenario was presented with each of the four types of signs.

As an example, the cliff scenario read as follows: "You have just arrived at a national park you've been planning a trip to all year. You look at park maps and talk to park guides to try to decide which trail to take to get the best views of the park and see some sights. You choose a trail and set out with your best friend, chattering about how excited you are to finally be here in such a beautiful place. After about 15 minutes of hiking through the woods, you come to a cliff where you can get a good view of the mountains and a lake, if you go past the trees and down towards the cliff edge a little bit. However, the cliff lies behind a sign that reads:" (see Figure 1 for images of signs).

Figure 1

Signs Used for Cliff Scenario with Four Different Normative Messages



The signs for each condition had similar design and messaging but were tailored to each scenario's risk (see Appendix for the remaining signs and scenarios). After presentation of the sign, the participants were asked two questions which served as the dependent measures of likelihood to hike and perceived likelihood to get hurt. For the cliff edge scenario, the "likelihood to hike" question was: How likely are you to decide to go beyond the sign close to the edge of the cliff? The "perceived likelihood to get hurt" question was: How likely do you think it is that you would fall if you went too close to the edge of the cliff? Both questions used the same rating scale response (1 = *not at all likely*, 5 = *somewhat likely*, 9 = *very likely*). The two likelihood questions were tailored to the risk in each scenario.

To measure self-exempting beliefs, the authors took the self-exempting belief statements from Oakes et al. (2004) and revised them to fit the content of each scenario. Eleven of Oakes et

al.'s (2004) sixteen statements were able to be revised in a way that made sense for a hiking context, differing slightly for each scenario. An example statement for each type of belief follows, showing how each was modified for the specific risk (see Table 1 for all final statements included): Skeptic (3 items)—the risk of [falling rocks on this trail / being gored by bison on this trail / people falling off the cliff / lightning strikes on this trail] is probably exaggerated; bulletproof (4 items)—I can prevent [getting hit by rocks on this trail / getting gored by bison on this trail / falling off the cliff / getting injured as a result of the lightning storm] if I am careful and pay attention; worth it (2 items)—I would rather take some risks and enjoy life than always be careful and miss out on adventure (same for all scenarios); jungle (2 items)—[Hiking this trail / Hiking near bison / Going out on this cliff / Hiking this trail during a lightning storm] is no more dangerous than lots of other things people do. Participants used a *completely disagree* (1) to *completely agree* (9) rating scale to respond to these belief statements after each scenario.

After answering the questions for all four scenarios, participants responded to several scales measuring general risk and adventure seeking attitudes. Próchniak's (2014) Wilderness Novelty Seeking Scale measures a curiosity about and desire for new experiences in wilderness. Participants rated ten items (e.g., "I'm intrigued by wild natural landscapes") on a scale from *definitely untrue* (1) to *definitely true* (4) ($\alpha = .82$). Zaleskiewicz's (2001) Stimulating Risk Scale assesses a general preference for impulsive risk taking. The measure's ten items (e.g., "I often take risks just for fun") were rated on a scale from *does not describe me at all* (1) to *definitely describes me* (4) ($\alpha = .80$). Finally, the Recreational Risk subscale of the Domain-Specific Risk-Taking Scale (DOSPERT; Blais & Weber, 2006) was also included. The DOSPERT measures the likelihood of engaging in various risky activities. Six items (e.g., "Bungee jumping off a tall bridge") were rated on a scale from *extremely unlikely* (1) to *extremely likely* (7) ($\alpha = .78$).

At the end of the study, participants responded to some demographic questions. Participation took about 15 to 20 minutes. The study was approved by the university research ethics board prior to collecting data.

Data Analysis

Analyses were conducted in four steps using R 3.5.1, SPSS Version 25, and BMDP 1990.

First, principal component analyses with varimax rotation were conducted on the self-exempting belief items separately for each scenario. The number of factors was decided using multiple criteria, including the scree plot, VSS (very simple structure), and interpretability of the factors. Although Oakes et al. (2004) found a four-factor structure for their self-exempting beliefs scale, that structure was not a good fit for our data. The research team examined and discussed both the two- and three-factor models for each scenario, and settled on the three-factor model. The three factors closely resembled three of the four factors from Oakes et al.'s (2004) scale. After examining the squared multiple correlations for the items as well as the cross-loadings, two items were removed, and the three-factor models were re-fit. Factor congruence was then examined across all possible pairs of scenarios (Revelle, 2017). Factor scores used in the analyses were constructed by averaging the items loading above .40 on each factor (Gorsuch, 1983).

Second, to test the effects of the manipulated experimental variables on likelihood ratings and belief factor scores, individual ratings and scores were adjusted for potential scenario differences by subtracting the mean of each scenario (Keppel & Wickens, 2004). This method was developed by Keppel and others in order to remove practice effects from repeated measures designs. Because the adjustment procedure requires equal numbers of observations in each scenario, ten participants were randomly removed prior to calculation.

Third, repeated measures ANCOVAs were then carried out using as dependent variables the adjusted "likelihood to hike" and "perceived likelihood to get hurt" scores. We tested these as two separate dependent measures, although they were related (correlations ranged between -.30 to -.46 depending on the condition). While perceived likelihood to get hurt could influence likelihood to hike, it may also be the case that beliefs about how likely one is to get hurt are formed after a decision is made about whether to hike as a rationalization for that decision. Therefore, we remained agnostic about the causal direction of the relationship and analyzed them separately to look for differences in how sign content and self-exempting beliefs predict these two likelihood ratings. For each dependent variable, an initial model was run with the manipulated independent variables of norm type (descriptive vs. injunctive) and framing (positive vs. negative) as repeated measures, gender as a between-participant grouping factor, and all interactions between these three variables. Subjects was the random factor. Gender was included in these analyses because gender differences were found in studies of similar outdoor risk taking situations (Aucote et al., 2010; Girasek et al., 2016b). The degrees of freedom for the error terms were adjusted as described in Keppel and Wickens (2004).

For likelihood to hike, additional models also included the centered stimulating risk scores as a covariate and centered self-exempting belief factor scores as repeated measures covariates. Stimulating risk was found to be the strongest potential risk attitude covariate after analyzing all three risk attitude scales (the Recreational Risk subscale of the DOSPERT, the Wilderness Novelty Seeking Scale, and the Stimulating Risk Scale). These three risk attitude measures were correlated with each other (correlations between .35-.61), and when all three were included in the same model, none was a significant predictor. Therefore, we added each risk attitude scale separately to the model to determine which was the strongest predictor. Stimulating

risk attitudes contributed the largest increase in R^2 (.07, $p < .001$), so this predictor was retained in the full model (recreational risk $\Delta R^2 = .04$, $p = .004$; wilderness novelty seeking $\Delta R^2 = .01$, $p = .20$). The same process was undertaken for the perceived likelihood to get hurt dependent measure, but none of the risk attitudes added significantly to the predictive power of the model, so none were included in the final model (stimulating risk $\Delta R^2 < .001$, $p = .50$; recreational risk $\Delta R^2 < .002$, $p = .38$; wilderness novelty seeking $\Delta R^2 < .002$, $p = .38$).

The fourth step of our data analysis was an exploratory analysis of the influence of sign content on self-exempting beliefs. Repeated measures ANOVAs were carried out on the adjusted belief factor scores which included the independent variables norm type and framing, gender as a grouping variable, and the interactions between these three variables as fixed effects and subjects as the random effect.

Results

Factor Analyses of Self-Exempting Beliefs

The item loadings for the final principal component analyses of the self-exempting beliefs for each of the four scenarios are presented in Table 1. Inspection shows that the loadings were highly consistent across scenarios, and only four items showed cross-factor loadings greater than .30 across all scenarios (a total of 36 loadings). The three factors were highly similar to three of the four factors in Oakes et al. (2004). We labeled the factors “Skeptic,” “Bulletproof,” and “Worth it.” We analyzed factor congruence and found the factors to be highly similar across scenarios but distinct from each other (see Supplemental Materials for more details). Once the factor scores were calculated, correlations among the beliefs within scenarios and conditions were found to be significant but moderate in size (between Skeptic and Bulletproof rs = .39 to

.54; between Bulletproof and Worth it *r*s = .34 to .47; between Worth it and Skeptic *r*s = .23 to 39).

Table 1

Principal Component Analysis Loadings, Descriptive Statistics, and Reliability Coefficients for the Self-Exempting Beliefs

		Scenario			
Factor		Falling rock	Bison	Cliff	Weather
Skeptic	Mean	5.91	5.21	5.52	5.82
	(SE)	(0.11)	(0.12)	(0.12)	(0.11)
	Alpha	.70	.72	.71	.65
Risk is exaggerated (e.g., The risk of falling off the cliff is probably exaggerated)		.86	.76	.73	.84
Many people don't get hurt (e.g., Many people could probably hike this trail and not get injured)		.74	.68	.80	.86
The park managers just have to put these signs up so they don't get sued		.66	.84	.75	.47
Bulletproof	Mean	4.54	4.48	5.28	3.83
	(SE)	(0.13)	(0.13)	(0.14)	(0.14)
	Alpha	.84	.86	.88	.87
Only get hurt if don't pay attention (e.g., Hikers would only get gored by bison if they weren't paying attention or were being careless)		.82	.77	.82	.84
Prevent risk if careful (e.g, I can prevent falling off the cliff if I am careful and pay attention)		.81	.83	.86	.88
Person who won't get hurt (e.g., I am the sort of person who could hike this trail and not get hurt)		.74	.77	.73	.64
Really careless to get hurt (e.g., I would have to be really careless on the trail to put myself at risk of getting injured as a result of the lightning)		.71	.83	.82	.88

Worth it	Mean (SE) Alpha	4.58 (0.15) .67	4.30 (0.14) .68	4.54 (0.14) .70	4.31 (0.14) .62
I would rather take some risks and enjoy life than always be careful and miss out on adventure		.77	.84	.82	.81
Have to die of something (e.g., I have to die of something, so why not die doing something exciting that I love, like viewing wildlife)		.87	.83	.87	.84

Note. If the scale statements differed across the risk scenarios, a general description is given followed by an example from one of the scenarios. If the statements were the same, the exact statement is given. Cell entries for each item are principal component loadings.

Main Analyses Addressing Research Goals 1 and 2

Repeated measures ANCOVAs were run on each of the dependent variables to examine how sign content and self-exempting beliefs predicted judged likelihood to hike and get hurt. A sequence of models was run to illuminate the predictive power of the covariates beyond the manipulated sign content independent variables. For likelihood to hike, Model 1 included only norm type, framing, gender, and all interactions. Model 1 explained very little variance in likelihood to hike ($R^2 = .02$, $p = .76$). Model 2 added stimulating risk as a covariate, and explained significantly more variance ($R^2 = .09$, $p = .02$; $\Delta R^2_{\text{Model 1 to 2}} = .07$, $F(1,184) = 14.71$, $p < .001$). Finally, Model 3 added the three self-exempting beliefs (centered) as covariates and explained significantly more variance in likelihood to hike ratings ($R^2 = .41$, $p < .001$; $\Delta R^2_{\text{Model 2 to 3}} = .32$, $F(3,182) = 96.82$, $p < .001$).

Each of the three self-exempting beliefs contributed significantly to predicting likelihood to hike even when controlling for stimulating risk attitudes ($b = 0.27$, $p = .10$): skeptic ($b = 0.24$, $p < .001$), bulletproof ($b = 0.49$, $p < .001$), worth it ($b = 0.27$, $p = .001$). Participants who rated

the likelihood to hike higher were those who were more skeptical of the severity of the dangers, who believed that they would be able to prevent themselves from getting hurt (higher on bulletproof), and who felt the hiking benefits were worth the risks.

There were also significant main effects of the independent variables norm type and framing in Model 3. The means of these effects are presented in Table 2. The descriptive norm led to a significantly lower rated likelihood to hike than the injunctive norm, and the negative framing also yielded a significantly lower rated likelihood to hike than the positive framing (see Figure 2). After controlling for the covariates, gender was not a significant predictor of likelihood to hike. There was a marginally significant interaction between gender and framing, $F(1, 182) = 3.53$, $p = .06$. The effect of framing was slightly stronger for women than for men. No other interactions approached significance (ps > .16).

For perceived likelihood to get hurt, two models were run. Little variance in perceived likelihood to get hurt was explained by Model 1, which included only norm type, framing, gender, and their interactions ($R^2 = .03$, $p = .60$). Model 2, which added the three self-exempting beliefs (centered) as covariates, explained significantly more variance in perceived likelihood to get hurt ($R^2 = .28$, $p < .001$; $\Delta R^2_{\text{Model 1 to 2}} = .25$, $F(3,182) = 64.12$, $p < .001$). Only skeptic ($b = -0.43$, $p < .001$) and bulletproof ($b = -0.24$, $p < .001$) beliefs contributed significantly to the prediction of perceived likelihood to get hurt. Participants who were more skeptical of the risks and who believed that they themselves would be able to prevent getting hurt (higher on bulletproof), rated the likelihood of getting hurt lower. Worth it beliefs were not significant predictors of perceived likelihood to get hurt ratings ($b = 0.02$, $p = .16$). In Model 2, there were also significant main effects of framing and gender, but not norm type. Negative framing led to

greater ratings of likelihood to get hurt than positive framing and women reported greater likelihood to get hurt than men. No interactions approached significance (*p*s > .50).

Table 2

Adjusted Means, SEs, and ANCOVA Results for the Dependent Variables as a Function of Each Independent Variable and Gender

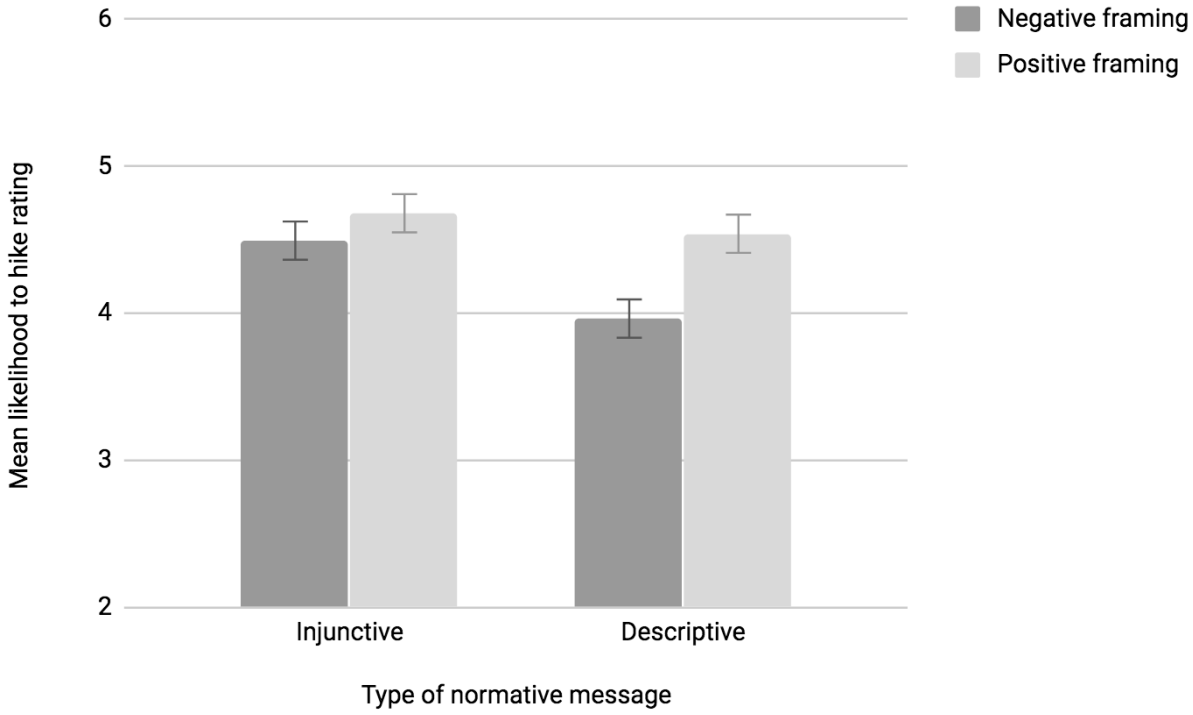
	Likelihood to hike	Perceived likelihood to get hurt
	M (*SE*)[a]	*M* (*SE*)[b]
Norm Type		
Injunctive	4.59 (0.09)	4.70 (0.08)
Descriptive	4.25 (0.09)	4.69 (0.08)
	$F(1, 182) = 6.06$, $p = .01$ $\eta_p^2 = .03$	$F(1, 182) = 0.02$, $p = .89$ $\eta_p^2 < .001$
Framing		
Positive	4.61 (0.09)	4.54 (0.08)
Negative	4.23 (0.09)	4.86 (0.08)
	$F(1,182) = 9.00$, $p = .003$ $\eta_p^2 = .05$	$F(1, 182) = 8.24$, $p = .005$ $\eta_p^2 = .04$
Gender		
Men	4.27 (0.18)	4.53 (0.17)
Women	4.57 (0.15)	4.86 (0.14)
	$F(1, 181) = 2.19$, $p = .14$ $\eta_p^2 =. 01$	$F(1, 182) = 10.08$, $p = .002$ $\eta_p^2 = .05$

[a]Adjusted means are from linear model with covariates: stimulating risk, skeptic, bulletproof, and worth it beliefs.

[b]Adjusted means are from linear model with covariates: skeptic, bulletproof, and worth it beliefs.

Figure 2

Adjusted Mean Likelihood to Hike Ratings for Each of the Four Warning Signs



Note. Adjusted mean likelihood to hike rating was on scale from *not at all likely* (1) to *very likely* (9). Adjusted means are from the linear model with covariates: stimulating risk, skeptic, bulletproof, and worth it beliefs. Bars represent +/- one standard error.

Exploratory Analyses

Finally, repeated measures ANOVAs were run on each of the self-exempting belief factors for an exploratory examination of whether the sign manipulations influenced beliefs. Norm type had no significant effects on any of the beliefs (see Table 3). Framing had a significant effect on skeptic beliefs. Reading the negatively framed messages led to lower beliefs about the risks being exaggerated than reading the positively framed messages. Framing had a marginally significant effect on bulletproof beliefs. Reading the negatively framed messages led

to slightly lower beliefs about being immune to the risks than reading the positively framed messages. Framing did not significantly influence worth it beliefs. There were also significant differences between men and women on the bulletproof and worth it beliefs, but not on skeptic beliefs. Men's bulletproof and worth it beliefs were higher than women's. There were no significant interactions between any of the independent variables or gender (*p*s > .10).

Table 3

Main Effect Means, SEs, and ANOVA Results for the Self-Exempting Beliefs as a Function of Each Independent Variable and Gender.

	Skeptic *M*(*SE*)	Bulletproof *M*(*SE*)	Worth it *M*(*SE*)
Norm type			
Injunctive	5.65 (0.10)	4.59 (0.10)	4.50 (0.14)
Descriptive	5.54 (0.11)	4.53 (0.11)	4.46 (0.14)
	$F(1, 184) = 1.42, p = .24$ $\eta_p^2 = .01$	$F(1, 184) = 0.29, p = .59$ $\eta_p^2 < .01$	$F(1, 184) = 0.29, p = .59$ $\eta_p^2 < .01$
Framing			
Positive	5.70 (0.10)	4.67 (0.11)	4.46 (0.13)
Negative	5.48 (0.11)	4.46 (0.11)	4.50 (0.14)
	$F(1, 184) = 6.06, p = .02$ $\eta_p^2 = .03$	$F(1, 184) = 2.99, p = .09$ $\eta_p^2 = .02$	$F(1, 184) = 0.22, p = .64$ $\eta_p^2 < .01$
Gender			
Men	5.69 (0.15)	4.93 (0.14)	4.81 (0.20)
Women	5.50 (0.13)	4.20 (0.12)	4.15 (0.17)
	$F(1, 184) = 0.97, p = .33$ $\eta_p^2 < .01$	$F(1, 184) = 15.01, p < .001$ $\eta_p^2 = .08$	$F(1, 184) = 6.36, p = .01$ $\eta_p^2 = .03$

Discussion

There were two main findings of this study that address the proposed research goals. First, there were small but significant effects of the types of normative messages after controlling for the covariates. Warning signs with *negative* framing (instructing people what *not* to do) were more effective at decreasing rated likelihood to hike in a hypothetical risky situation than positively framed signs (instructing people what they should do). Negatively framed messages also increased beliefs about the likelihood of getting hurt if one were to hike relative to positively framed messages. The increased effectiveness of negatively framed messages coincides with previous literature on the enhanced impact of negative stimuli, possibly because negative information carries more information value (for reviews, see Baumeister et al., 2001; Rozin & Royzman, 2001).

However, in contrast to our hypothesis that signs with negative injunctive norms would be most effective (based on the findings of Cialdini et al., 2006, and Winter, 2006), our study found that the *descriptive* normative messages with negative framing were the most effective at reducing reported likelihood to hike in a risky situation. Cialdini et al. (2006) and Winter (2006) hypothesized and found that the negatively framed descriptive normative message was the *least* effective at deterring unwanted hiking behavior that posed a threat to natural resources. The logic behind descriptive messages being less effective for deterring action that can damage natural resources is that a descriptive message focuses the audience on the fact that many people are doing the undesirable behavior, thus highlighting that the unwanted behavior is the norm (Cialdini et al., 2006). However, the normative messages used in this study were focused on safety rather than resource protection. Our negatively worded descriptive norms stated that many people had gotten hurt by not being safe, whereas the injunctive norms stated that the hiker *could*

get hurt. Knowing that others have gotten hurt may make the risks of injury more salient. However, the descriptive normative message with negative framing did not lead to a greater assessment of the likelihood of injury.

The normative messages may have worked differently in the present study compared to Cialdini et al. (2006) and Winter (2006) for a few reasons. Communicating a negative descriptive norm in the previous studies meant highlighting that others had participated in this negative behavior that benefited them, but you should not. In the previous studies, there was no mention of personal negative consequences of violating the rules, only consequences to the environment. Instead there were benefits to the individual if they violated (i.e., obtaining petrified wood or getting to explore more of the park). This not only establishes a norm opposite of the one that is desired, but it also sets up a situation where the hiker may feel it is unfair that they should have to follow the rules (and sacrifice personal benefits) when others have not. A desire for fairness has been shown to be an important motivating factor in natural resource dilemma situations (Wilke, 1991). In contrast, the negative descriptive norm used in the current study communicated that others had broken the rules, but they did not benefit from doing so, instead they got hurt. In this situation, it is unlikely hikers would think it unfair that others got to break the rules and get hurt, while they cannot. The negative consequences were included on each sign in this study because that is considered one of the crucial components of effective warning messages (Wogalter et al., 2002).

Addressing the second research goal, the results showed that although the normative messages had significant effects on likelihood to hike and get hurt ratings, these effects were greatly overshadowed by the predictive power of the self-exempting beliefs—skeptic, bulletproof, and worth it. As hypothesized, skepticism of the dangers as well as bulletproof

beliefs (beliefs that one was immune from or could easily prevent the risks) predicted greater likelihood to hike and lower likelihood to get hurt ratings. In addition, beliefs that the risks were worth it predicted greater likelihood to hike, but not perceived likelihood to get hurt.

These self-exempting beliefs were measured with a situation specific scale adapted from Oakes et al.'s (2004) scale for smoking risks. It is also worth noting that the three factors we found for the self-exempting beliefs were closely related to those of Oakes et al., with the exception that we did not find a clear "jungle" factor relating to the concept of dangers being everywhere. The factors showed good convergence across the four hiking decision scenarios in our study. Although this convergence is not unexpected because the participants answered similar questions for each of the scenarios, it is still encouraging for future use of the belief scales in different contexts. The scale items can be easily modified to many different recreational risk situations by making small changes to the wording.

Given the power of the self-exempting beliefs to predict ratings of likelihood to hike and get hurt, in the future, it would be useful for researchers to specifically test warning messages designed to target these beliefs. Although the warning messages in this study were not created with the intent to influence self-exempting beliefs, the exploratory analyses that we conducted showed that negative message framing decreased skeptic beliefs. Information that gets hikers to understand that they are not immune to the risks could potentially reduce bulletproof beliefs. For example, researchers could test whether a short story about an experienced hiker who was injured could counter beliefs that only careless hikers who don't know what they are doing will get hurt. Looking to other research on concepts similar to skeptic and bulletproof beliefs (e.g., self-positivity bias, optimism bias, self-efficacy) could suggest other ways to target this belief. Perceived controllability is related to both optimism bias (see Harris, 1996, for a review) and

self-efficacy (Llewellyn et al., 2008; Merritt & Tharp, 2013), such that reducing hikers' perceptions about their ability to control a risky situation could also decrease their beliefs that they are immune to the risks. Indeed, in this study, bulletproof beliefs were lowest in the risky weather scenario, which could be viewed as the least controllable risk, and were highest in the cliff edge, likely perceived as the most controllable risk (see Table 1). Lin et al. (2003) also manipulated perceived controllability as well as base rate information about an illness and found that those two manipulations together eliminated the self-positivity bias. Base rates for recreational accidents and injuries are difficult to obtain because of a lack of a denominator for the number of hikers. Still, it would be worth investigating whether providing the frequency of reported injuries or accidents that occur at a park each year could have similar effects. Finally, Menon et al. (2002) found that giving people examples of frequently performed behaviors that can transmit an illness led to less self-positivity bias than listing infrequently performed behaviors. Researchers could explore whether giving hikers examples of frequently performed behaviors that can lead to accidents or injuries (e.g., taking selfies on the trail, getting closer to wildlife to take pictures, ignoring warning sign information) could similarly reduce bulletproof and skeptic beliefs. Future studies could focus on some of these ideas for tailoring warning message information to minimize self-exempting beliefs.

Limitations

A noteworthy limitation of this study was the use of hypothetical hiking scenarios and signs, although we measured behavioral intentions (likelihood to hike) which are at least moderately related to behavior. For example, Ajzen and Driver (1992) found that intention to participate in any of five leisure activities predicted self-reported participation a year later, accounting for 11 to 52 percent of the variance. It is difficult to say whether the signs would be

more or less effective in real life rather than in a hypothetical situation. In a real hiking situation, the dangers described would pose actual risks to the participants, which could increase attention to the warnings. However, participants may have been more likely to fully read and remember the signs in our hypothetical study because they were focused on the task at hand and receiving extra credit for their academic courses, a context that might promote attention. Research has shown that many hikers ignore trail signs; for example, Heggie and Heggie (2004) found that only 24% of hikers reported reading trailhead warning and information signs or speaking to a ranger before starting a hike at Hawaii Volcanoes National Park. Conversely, Aucote et al. (2012) found that most beachgoers noticed safety warning signs about unstable cliffs, but a majority incorrectly interpreted the signs. It would be worthwhile to direct more research toward investigating factors that influence not only whether park visitors read safety warning messages, but also how they interpret and remember that information.

Another limitation is that the participants in our study were college students, although we screened them for recent hiking experience. Nevertheless, the participants were young adults, an age bracket that is likely to take more risks (Duell et al., 2018) and possibly have higher self-exempting beliefs than other age groups. Given this, it is worth pointing out that the means on the likelihood to hike and get hurt scales generally fell around the midpoint of the scale. Participants were not just ignoring the risks because they were hypothetical or because they were young adults. In open-ended comments that we solicited at the end of the study, many commented on the serious nature of the risks and not wanting to get hurt, suggesting that they were taking the risks seriously. The age of the sample poses a further limitation because McEachan et al. (2016) found that descriptive norms were more strongly predictive of risky

health behaviors for children and college students than for older adults. Therefore, the effectiveness of the descriptive normative message may be weaker in an older sample.

A final limitation of our study was that we only studied the effectiveness of different normative messages; therefore, we don't know if normative messages are more or less effective than other types of information, such as possible sanctions for rule breaking. For example, some studies have found that adding sanctions to messages about park regulations increased compliance (Girasek, 2019; Gramman et al., 1995; Johnson & Swearingen, 1992). However, focusing on normative messages is appropriate for this study because normative messages seem to be commonly used. Winter et al. (1998) examined signs at recreational areas in California and Arizona, focusing on messages related to resource protection, and found that the majority of messages were negatively framed injunctive messages and almost no signs used descriptive norms. It would be interesting to similarly survey warning signs and information related to safety messages to see if negatively framed injunctive messages are also most common in this context, since our study suggests negative descriptive norms might be more effective.

Conclusions and Implications

This study found small effects of normative message types and framing, with negatively worded descriptive norms being the most effective warning signs for deterring risky behavioral intentions in hypothetical hiking scenarios. Park managers may find that providing descriptive normative information about hiker accidents and injuries that resulted from disobeying warning information could reduce risky hiking. In addition, this study showed that situation-specific self-exempting beliefs were more strongly related to risky behavioral intentions than either sign content or currently available risk attitude measures. It may be useful for park managers to assess the self-exempting beliefs that are held by hikers who fail to comply with specific warnings. For

example, do the hikers believe this particular risk is exaggerated? Do they believe that they are capable of preventing a potential accident in this situation? Do they believe that the benefits of the activity outweigh any risks? Then, warning messages could be created that deliberately attempt to reduce these specific self-exempting beliefs. A recent study of bison injuries in Yellowstone National Park concluded that visitors' failures to comply with rules are "a significant problem in national parks", and called for "using behavior science approaches for injury prevention and control" (Cherry et al., 2018, p. 5). Yet, there is a lack of research on effective safety warnings in parks (Saunders et al., 2019). In conclusion, this study's findings add to the much needed research on hikers' compliance with safety rules and warnings conveyed in park handouts and signs.

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Appendix

Additional Risky Hiking Scenarios and Warning Sign Messages

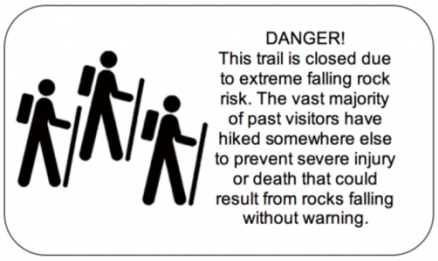
Falling Rock

Imagine you and a couple of friends are planning a hike at a trail in a nearby state park. You have never visited this park before, but heard it has great views and some challenging terrain. You have been planning and looking forward to this hike all week. You drive to the state park, put on your packs with your food, water, and other supplies needed for the day long hike and walk over to the trailhead. At the trailhead, you see the following sign:

Positive Injunctive

Negative Injunctive

Positive Descriptive

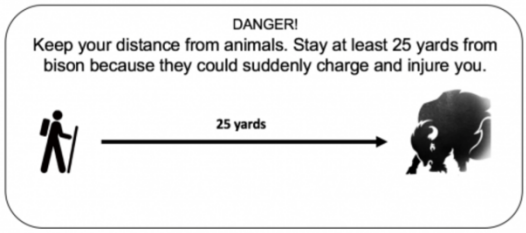


Negative Descriptive

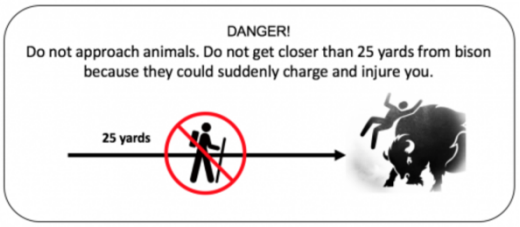
Bison

You and some friends are planning a hike in Yellowstone National Park. You have never visited Yellowstone before, but heard it has great wildlife along with the hot springs and geysers. You hope you will get a chance to see moose, bears, and bison to really make your trip special. You arrive at the park, put on your backpacks with your supplies for the day, and head over to the start of the trail, where you see the following sign:

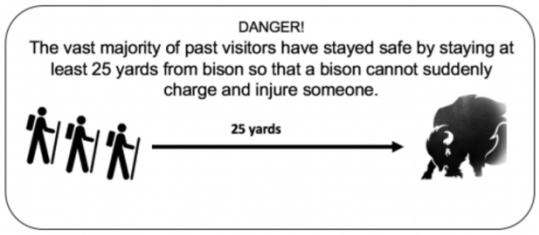
Positive Injunctive



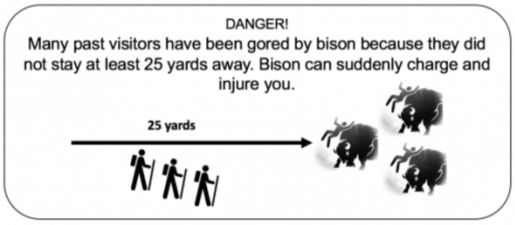
Negative Injunctive



Positive Descriptive



Negative Descriptive



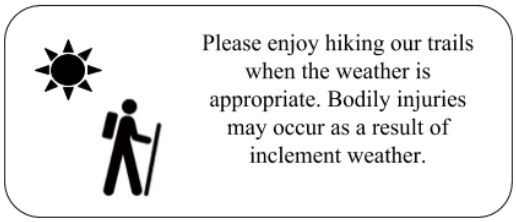
After you and your friends notice the sign, you look across the meadow where the trail goes. There are two bison standing very close to the trail. Right now they are more than 25 yards from you, but if you continue hiking on the trail you will be less than 25 yards away from the bison.

Weather

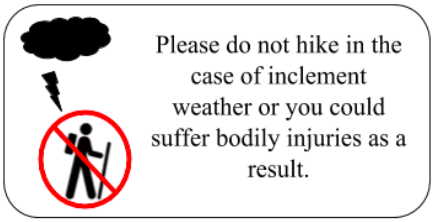
Imagine you are planning to hike in a wilderness area with your friends. You've been researching this area for months now and you believe you have put together the perfect itinerary. The best time to visit is in the spring when it is a bit cooler and you can catch some views of flowers blooming and animals coming out of hibernation. Several adventure blogs that you've read also warn that this is the rainy season and you risk not being able to hike in the case of inclement weather. Given this location, thunder and lightning storms are likely and may create dangerous situations and increase the risk of severe injury. A little rain never hurt, right? You decide to book your trip for the spring anyway and order some new rain gear for the hike. This is bound to be the adventure of a lifetime!

The day of your hiking trip comes and you arrive at the start of the trail. At the trailhead, you see the following sign:

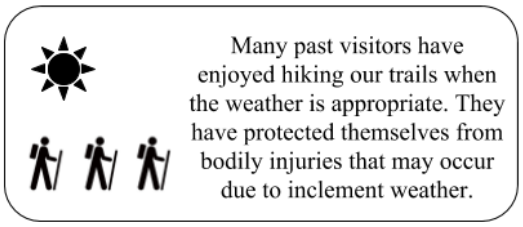
Positive Injunctive



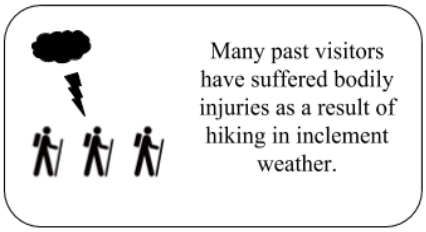
Negative Injunctive



Positive Descriptive



Negative Descriptive



As you begin your hike you are enjoying the scenic views and are totally consumed in nature.

After about 10 minutes, you hear a rumble and start to see some dark clouds rolling in overhead.

You see lightning in the distance and a light rain begins.

Supplemental Materials

Factor Congruence

We formally analyzed factor congruence across scenarios using two methods recommended by Revelle (2017). First, we used the 'factor.congruence' R function in the 'psych' package, which is based on the cosine of the angle between the factors (when cosine = 1, the angle between factors is zero). The results showed that the minimum cosine was 0.92, implying that the factors are nearly collinear across scenarios. Second, we used factor loadings from each scenario to calculate predicted scores for the other scenarios, and then correlated the predicted factor scores with the actual factor scores. The minimum correlation across scenarios for matching factors was 0.90. The maximum correlation between non-matching factors across scenarios was 0.21, with all other non-matching factor correlations below 0.15. Therefore, the factors are highly similar across scenarios but distinct from each other.