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RESEARCH ARTICLE

Mobilizing the Public in Saving the Bonneville Salt Flats: Understanding Blame as a Psychological Construct

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ABSTRACT
This study seeks to explicate blame as a psychological construct. Situated in the environmental problem of the decline of the Bonneville Salt Flats (BSF), the study examines the structure of blame and how it may mediate message effect on the public's issue engagement to save the BSF. With data collected from a Web-based experiment on a college student sample, blame was shown to be best modeled as a latent construct consisting of both the cognitive component of responsibility judgment and the affective component of anger. Blame was stronger when the scientific research findings were communicated in certain vs. uncertain language and was in turn a predictor of behavioral intentions to protect the BSF, including punitive attitudes against the perceived wrongdoers, information seeking and sharing activities, and civic participatory behaviors. Our study offers a psychological account of blame as a useful explanation of the effect of environmental communication on issue engagement.

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KEYWORDS
Blame; responsibility; anger; scientific uncertainty; public engagement

> … (B)lame is, for better or worse, a central part of human relationships … we are (in fact) beings who evaluate, react, and respond to each other (and ourselves) along various normative dimensions. (Coates & Tognazzini, 2012, p. 3)

Blame is a pervasive human experience. We blame our partner, boss, president, or ourselves for one thing or another, with or without expressing it. We witness or participate in various blame wars on news or social media over issues of politics, health, and environment, sometimes with vehement disagreements over what or whom to blame. To blame is a part of being human, as "social judgment and social justice are among the essential human preoccupations" (Weiner, 1995, p. 24).

Despite its pervasiveness in our everyday life, blame remains "an elusive notion" in academic research (McKenna, 2012, p. 119), attracting growing efforts in social psychology (Malle, Guglielmo, et al., 2014) and philosophy (e.g. Coates & Tognazzini, 2012) to delineate its conceptual underpinning. Communication scholars have so far mostly approached blame as a feature of media coverage on controversial issues (Holton et al., 2012; Romer et al., 1998), with more recent research focusing on how differential responsibility attributions in media discourses, or "blame frames," shape public opinion and actions (Hameleers et al., 2017, 2018). Such research shares the premise that eliciting blame can be a powerful way of constructing social reality.

Sharing this premise and building on the extant research, our study seeks to explicate blame as *a psychological construct*. Our theoretical goal is to shed light on the psychological properties of blame

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as an explanatory mechanism of message effects on the public's responses. To this end, we first address the nature of blame: Should blame be conceptualized and operationalized as primarily cognitive, affective, or both? Second, we examine blame as a mediating process that connects communication messages and potential social actions.

We conduct this inquiry in the context of an environmental problem, the decline of the Bonneville Salt Flats. It is of practical importance for environmental researchers to understand how styles of communication may influence the public's pro-environmental issue engagement. Specifically, we focus on the portrayal of scientific findings in certain vs. uncertain language, a line of research with growing importance to which we hope to contribute further theoretical and empirical insights. We report results from data collected via a Web-based experiment using a college student sample.

The decline of the Bonneville Salt Flats

The Bonneville Salt Flats (BSF) is a 30,000-acre, densely packed salt pan located in Tooele County in northwestern Utah. The Salt Flats are remnants of prehistoric Lake Bonneville, a saltwater body that at one time covered over 19,000 square miles in the American West. In addition to the sublime landscape, BSF is best known for being a world-renowned land-speed racing track, but the condition of the BSF has been deteriorating. The Flats' surface area is shrinking; and the salt crust, which gives the Flats its famously smooth and glassy surface, is thinning. Such changes in the BSF's surface properties "have led to concerns about land use sustainability and potash mining mitigation efforts" (Bowen et al., 2018).

Many factors related to human activities could contribute to the decline of BSF, though no definitive conclusion has been reached (Penrod, 2017). In this study, we focus on land-speed racing, the most salient and high-profile human activity that takes place on BSF, as a likely candidate for contributing to the BSF decline. Land-speed racing has been a popular activity since the 1930s. When the salt conditions are good enough, several annual racing events, such as *Speed Week* and *World of Speed,* are held on the Flats. Racing on slushy or soft salt can leave long-term damage, a potential cause of the decline of BSF. To emphasize, though, the aim of our study is to advance theoretical and empirical understandings of blame in a communication process, not to make any claim about car racing as a more or less important factor in relation to the BSF decline.

Explicating blame as a psychological construct

The term blame designates a vast conceptual terrain. Our study, first of all, concerns "event-related blame" as opposed to "characterological blame" (i.e. blaming people for who they are, see Alicke, 2014). For blame to occur, a negative event has to be detected, where an agent is perceived to have transgressed or violated norms (Malle, Monroe, et al., 2014).[1] Blame differs in *form* and *target*. In terms of form, blame can refer to an internal state (i.e. one's psychological reactions to perceived norm violations) or overt expressions of disapproval or punishment (such as verbal accusations or giving someone a cold shoulder, Malle, Guglielmo, et al., 2014; McKenna, 2012). The target of blame can be oneself (self-blame) or others (other-blame) (Besharat et al., 2001). To draw the conceptual boundaries for this study, we will focus on *other-directed blame* as a *psychological response,* given our interest in blame as an explanatory construct for better understanding communication processes regarding social issues.

Existing theoretical efforts in psychology research mostly explicate blame as a nomological network and map out complex decision processes wherein the blame judgment is embedded. Prior work on blame has tackled connections and differences between blame and attendant concepts. For example, blame is shown to be empirically differentiable from controllability (Mantler et al., 2003) and wrongness (Cushman, 2008), which are respectively judgments about the agent or the event alone. Blame, in comparison, requires that the causal connection between the agent and the event be established. Theoretical models of blame have proposed various decision stages involving assessments of blame criteria such as causation and intent (Malle, Monroe, et al., 2014; Shaver, 1985) or the process of validating blame on the basis of culpable control (Alicke, 2000). Malle, Guglielmo, et al.'s (2014) "theory of blame" encompasses both blame as a cognitive decision (i.e. someone is blameworthy) and blame as a social act (i.e. expressing disapproval or sanction) and describes the processes where cognitive blame arises and leads to social blame, which in turn functions as behavioral regulation. These theorizing efforts explicate blame as a socio-cognitive system of moral criticism formed and expressed.

In the extant literature, one residing struggle is to define what blame *is* as a psychological construct. Researchers have suggested or treated blame as a cognitive judgment, a reactive emotion, or both. To begin, blame has mostly been conceptualized as a cognitive judgment. As such, blame differs from a mere moral evaluation (e.g. "stealing is wrong") and involves an attribution process wherein *responsibility* of the perceived wrongdoer is determined (Alicke, 2014; Malle, Monroe, et al., 2014).[2] Responsibility is a propositional belief about the relationship between the agent and the event or the outcome, a judgment that relies on available socio-cognitive information, such as intentionality, or causal reasoning. Researchers often equate responsibility and blame (Fincham & Shultz, 1981; Shultz et al., 1981) and directly measure blame as perceptions of responsibility or accountability (Hameleers et al., 2018; Quigley & Tedeschi, 1996; Zagefka et al., 2011).

Other literature has highlighted the affective nature of blame (Besharat et al., 2001; Smith, 2013). To blame someone is a distinctive emotional response to perceived manifestations of ill will or disregard (Strawson, 1962) and an experience of being "emotionally exercised" by the wrongdoing (Smith, 2013, p. 31). Blame, central to moral psychology, is a righteous emotion. It consists in *reactive sentiments* that are "backward-looking … responses to particular violations of moral obligation" (Wallace, 1994, p. 75). One cannot blame without feeling resentment or indignation toward the perceived wrongdoer (other-blame) or guilt and shame toward oneself (self-blame) (Wallace, 1994). Such emotional reactions, according to this line of theorizing, constitute the essence of blame. In discussing blame directed at others, some researchers have accentuated the shared properties between anger and blame (Averill, 1983; Wranik & Scherer, 2010). Sheikh and McNamara (2014) explicitly contend that "certain emotion categories are in fact types of blame" (e.g. anger, disgust, contempt, shame).

Neither attribution nor emotion alone, however, should define blame if it is a unique construct. Not all responsibility attributions are blame, as blame has an inherently negative connotation. As Weiner (1995) put it, " … responsibility is affectively neutral, whereas blame conveys emotional negativity" (p. 14). To blame, more than a claim of an agent's responsibility, is "more likely to imply moral wrongdoing" (Robbennolt, 2000, p. 2582). Blame is not merely an emotion, either. Anger can be caused by an impersonal event and does not require justification (Malle, Guglielmo, et al., 2014). Here we hence highlight Weiner's (1995) proposal that blame is *a blend concept* of both cognition and emotion (Weiner, 1995). Analogous to the color green, which is a combination of yellow and blue but irreducible to either, Weiner (1995, p. 15) suggests that blame is "a cognitive–affective blend" that is neither the same with nor separable from its constituting elements. The conceptual relationship between blame, anger, and responsibility is depicted in Figure 1 (a reproduction of Figure 1.2 in Weiner, 1995, p. 16). Weiner's conception has been echoed by other researchers (e.g. Friedlander et al., 2000), who characterize blame as responsibility attribution accompanied by emotional responses such as anger (in other-blame) or shame (in self-blame). The alloy of both defines blame. As Weiner (1995) lamented, however, this conception of blame has not been empirically examined.

In this study, we take up this goal of analyzing the anatomy of blame and clarify its constituting conceptual and operational elements. We examine Weiner's conception of blame (specifically, other-blame) as a blend of responsibility judgment and anger, and test it against other possible conceptual models (Figure 2). Figure 2(a) depicts single process models where blame is either a cognitive judgment of responsibility or an affective reaction of anger. If blame is a process that involves both components, Figure 2(b) proposes serial causal processes where responsibility judgment leads

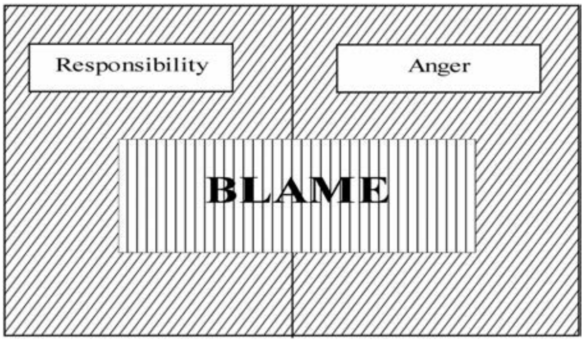


Figure 1. The relationship between blame, responsibility, and anger as depicted by Weiner (1995; reproduced from Figure 1.2, p. 16).

to anger or vice versa, and Figure 2(c) conceptualizes them as parallel pathways. Figure 2(d) depicts Weiner's (1995) conception of blame as a latent construct, a conglomerate of both responsibility judgment and anger, reducible to neither. Specifically, we seek to answer these questions:

RQ1a: Should blame be operationalized as a cognitive judgment, an emotional response, or both?

RQ1b: If blame has both cognitive and emotional components, how are the two combined?

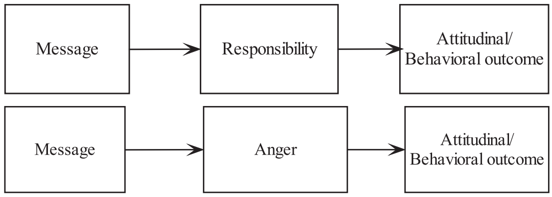
From message to action: the mediating role of blame

Approaching blame as a psychological response, our study seeks to examine it as an explanatory construct in understanding audience's responses to communication messages. Aligning with the burgeoning interest in scientific uncertainty in science and environmental communication (Corbett & Durfee, 2004; Peters & Dunwoody, 2016), the study looks at how communicating an environmental problem in certain vs. uncertain language may elicit different levels of blame. Scientific (un-)certainty is theoretically relevant as it strengthens or weakens perceived causal evidence, which is a precondition of the experience of blame (Alicke, 2000; Shaver, 1985). Below we first turn to a brief review of the literature on scientific uncertainty.

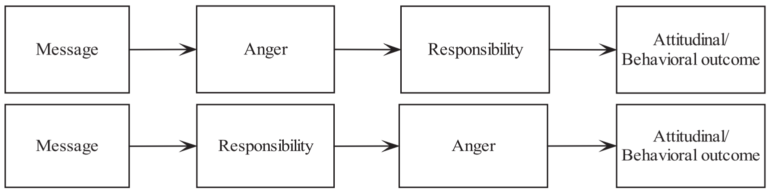
Uncertainty in scientific vs. popular discourses

Uncertainty is inherent to all scientific enterprises. Of central concern to communication researchers is how *epistemic uncertainty* (i.e. "the uncertainty about the validity of truth claims," Peters & Dunwoody, 2016, p. 894) is portrayed and perceived, and subsequently influences public opinion on specific issues or science in general. What is lost in the translation of uncertainty from the scientific literature to the popular discourses, and with what consequences, has in recent years become an important line of research in science communication.

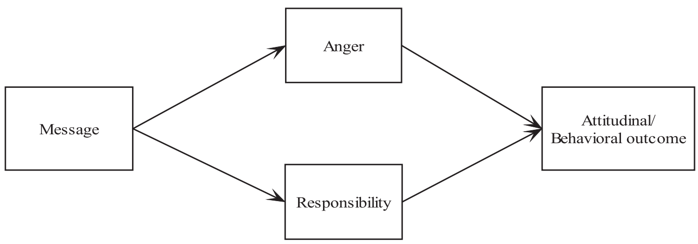
In communicating science to the public, scientific uncertainty can be amplified or attenuated, depending on the goals of communication. Most research has so far focused on reporting scientific uncertainty in journalistic contexts. Journalists can overplay uncertainty to make a story more controversial and sensational or to conform to the "fair and balanced" principle (e.g. on climate change, Guenther & Ruhrmann, 2016; Rice et al., 2018). In such cases, the amount of news coverage on dissenting views or inconsistent evidence can deflect from the scientific consensus, potentially leading to distorted perceptions among the public (Corbett & Durfee, 2004; Dixon & Clarke, 2013). On the other hand, uncertainty is often eclipsed to enhance the significance and uniqueness of a discovery, as it would hurt the news value to acknowledge the tentative, probabilistic nature of scientific



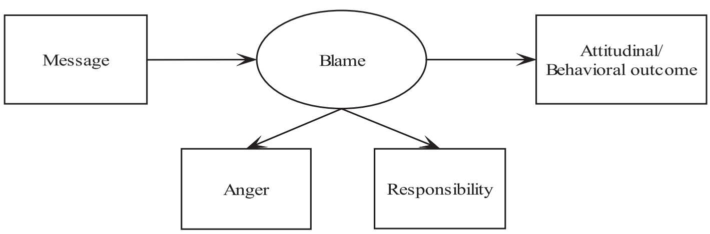
a. Single Process Models: Blame as purely cognitive or affective.



b. Serial Causal Models: Blame as encompassing a causal sequence involving anger and responsibility.



c. The Dual Process Model: Blame as consisting of parallel paths involving anger and responsibility.



d. The Intertwined Model: Blame as a blend construct of anger and responsibility.

Figure 2. Depictions of conceptual models. (a) Single process models: blame as purely cognitive or affective. (b) Serial causal models: blame as encompassing a causal sequence involving anger and responsibility. (c) The dual process model: blame as consisting of parallel paths involving anger and responsibility. (d) The intertwined model: blame as a blend construct of anger and responsibility.

findings (Fahnestock, 1998; Lehmkuhl & Peters, 2016; Peters & Dunwoody, 2016; Stocking & Holstein, 1993). Omitting uncertainty may create a sense of "undue certainty and closure" and mislead the public (Weiss & Singer, 1988, p. 132). In other contexts, research has also shown that policy advocates may under-present the uncertainty of findings that support their proposals but accentuate it when it comes to oppositional claims (Campbell, 1985; Shackley & Wynne, 1996). In this study, we choose to examine scientific uncertainty in an informational brochure, a genre of messages common to environmental communication campaigns. In such promotional materials, when the scientific evidence supporting an environmental cause is represented in certain vs. uncertain language, how may that affect the public's reactions to such messages?

Uncertainty can be reported through various strategies, such as by pointing out gaps in research, acknowledging caveats or limitations, and presenting inconsistent evidence or controversial claims (Corbett & Durfee, 2004; Dixon & Clarke, 2013; Stocking & Holstein, 1993). The present study manipulates uncertainty by using hedges, which are lexical qualifiers expressing tentativeness "to make things fuzzier or less fuzzy" (Lakoff, 1973, p. 471), to highlight the inconclusiveness of findings. Hedges such as "maybe" or "possibly" serve to qualify the propositional statements for greater accuracy and/or reduce the author's assertiveness (Hyland, 1996). While it is a normative, professional conduct among scientists, hedging is often lost in the popular discourses on scientific findings (Fahnestock, 1998). Our choice of using hedging for the context of our study also reflects the current status of scientific research on this topic: Research is still ongoing to investigate the impact of environmental as well as human factors on the decline of BSF[3], although it has become a high-profile topic of discussion in the local news media.

Based on the above review, we first predict that:

H1: Reporting the scientific findings in certain vs. uncertain language will increase the public's perceptions of certainty about the human causes of the BSF decline.

Blame as a mediating process

Blame arises from "assigning meaning to an event" (Malle, Guglielmo, et al., 2014, p. 153). Establishing causality by connecting the negative event with an agent is a precondition for blame to occur (Alicke, 2000; Shaver, 1985; Malle, Guglielmo, et al., 2014). "[C]ausal beliefs of human involvement" precede and are differentiable from inference of responsibility (Weiner, 1995, p. 6). A causal link does not always lead to responsibility attribution, especially when there is sufficient justification for someone's action or when the event is beyond personal control. Research has shown that blame is heightened with increased perceptions of causal control (Alicke, 2000) and when the causal factor is more proximal (e.g. more recent in time, Lagnado & Channon, 2008).

In the context of BSF, the thinning and shrinking of this unique, sublime landscape is reasonably expected to be perceived as a negative outcome. Car racing on the Salt Flats, especially with the annual racing events, are likely to be deemed a preventable and proximal causal factor. Language certainty increases the perceived validity of causal claims. When scientific findings on this potential human cause are reported in a certain tone, it may serve to strengthen the perceived causal link between car racing and the decline of BSF, thereby intensifying blame as a response to the message. Therefore, we predict that

H2: Perceived certainty of scientific findings on the decline of the BSF positively predicts blame.

Blame's primary function is to regulate social behavior (Malle, Guglielmo, et al., 2014). Even if blame does not have to be verbally expressed, blame "by its nature has an expressive point and a broadly communicative aim" (Smith, 2013, p. 39), because it registers the perceived damage and motivates one to seek repair. As an inherently negative reaction to perceived norm violations, blame can be a driving force of social actions to restore the situation. Depending on the way a social problem is communicated to the public, blame, when elicited, can powerfully shape or propel subsequent social responses. In Weiner's attributional theory of motivation, blame serves to "direct social behavior toward others" (1995, p. 3). Regarding environmental problems, such social responses can encompass various forms of issue engagement to prevent further transgressions. In this study, we focus on three such social responses, described in the following prediction:

H3: Blame positively predicts the public's issue engagement, including a) prohibitive attitudes toward car racing on the BSF and greater intentions to engage in b) informational activities and c) civic participatory behaviors to save the BSF.

Consisting of cognitive and affective reactions elicited by the message, blame can be an explanatory pathway that channels the effect of the communication message on individuals' intention to engage in future actions. In other words, blame is theorized as a psychological mechanism accounting for the message effect. In Hameleers et al. (2018), blame perceptions (measured as perceived responsibility) were shown to mediate the effect of the media message on voting preference for the populist party. Based on our hypotheses about blame as an outcome that follows communication messages (H2), and about blame leading to attitudinal and behavioral outcomes (H3), it is reasonable to expect blame to function as a mediating process connecting exposure to communication message and subsequent behavioral intentions. We hence posit the following hypothesis on the mediating role of blame:

> H4: Blame mediates the relationship between perceived certainty and intentions to engage in various actions to save the BSF as specified in H3.

Method

Sample

Undergraduate students ($n = 310$) enrolled in communication classes at a large western university participated in the study in exchange for a small amount of extra credit. The study was approved by the university's Institutional Review Board. Data were collected in a two-week period in April 2018. The sample included a majority of female (67%) and Caucasian (80%) participants, with an average age of 23.5 (SD = 4.6). Participants received the URL to an online survey, designed on Qualtrics, and completed it at a location of their choice.

Study design

Data were from a larger web-based, between-participants experiment. Analyses reported in this paper were based on the experimental factor of language certainty vs. uncertainty.[4] The stimulus material consisted of two pages of information about the Bonneville Salt Flats (BSF), presented on two consecutive screens in the online survey. These two pages, allegedly "from a brochure that is being developed to raise people's awareness about the Bonneville Salt Flats," described BSF as a unique landscape, the car racing for which it was famous for, and research findings about the thinning of the salt flats. It featured a researcher's remarks about human activities being a potential causal factor of the decline of the BSF.

Manipulation of uncertainty, based on Hyland (1996)'s work on hedging, included reliability indicators such as "*may* be responsible … " or emphasizing "data are *inconclusive* … ," and equivocal researcher commitment to the findings via *impersonal expressions* (e.g. "*Her two years of research leads* her to think … "). The title was also either a categorical statement ("Decline: The Salt Flats in Danger") or an expression of indeterminacy ("Decline: An Uncertain Future"). The texts of the stimulus materials are included in the Appendix. Following O'Keefe's (2003) argument that manipulation checks are not necessary for intrinsic message features, manipulation checks were not performed and perceived certainty was included as a mediating variable in the model.

Key measures

Perceived certainty

Following the two-page reading, participants were asked to rate two sets of items on 7-point semantic differential scales. One set of items asked participants whether they regarded "the scientific evidence on human activities causing the Bonneville Salt Flats decline" as "preliminary" vs. "established," and "conclusive" vs. "inconclusive" (reverse-coded). They were also asked to rate whether "the researcher in this brochure sounds … " "tentative" vs. "sure," and "uncertain" vs.

"certain." Although these four items were intended to capture perceived certainty of scientific evidence and the tone of the researcher separately, confirmatory factor analyses showed that the one-factor model was superior to the two-factor model.[5] We, therefore, combined the four items into one scale of perceived certainty ($\alpha = .77$, $M = 4.71$, SD = 1.69).

Responsibility judgment

Three items were used to capture the extent to which car racing on BSF was perceived to be the cause of its decline (1 = *strongly disagree*, 7 = *strongly agree*): "Car racing is mainly responsible for the decline of the Bonneville Salt Flats;" "Car racing is one of the human activities that are destroying the landscape;" and "Car racers should acknowledge responsibilities in thinning the Bonneville Salt Flats." The three items, exhibiting high reliability ($\alpha = .82$), were combined into a scale of responsibility attribution ($M = 4.81$, SD = 1.33).

(Moral) Anger

As a concept central to moral psychology, blame has a moral kernel. In Gamson's (1992) words, individuals often react to perceived injustice or violation of moral standards with "righteous anger" (p. 32). To measure such moral anger, we modified Hwang et al.'s (2008) measure of "media indignation." Respondents were asked "when you were reading these two pages, to what extent did you feel each of the following emotions?" (1 = *none*, 5 = *a lot*). Three items, "angry," "outraged," and "disgusted," were used to construct the scale of moral anger.[6] The three items loaded on one factor were combined into one scale ($\alpha = .90$, $M = 2.16$, SD = 1.12).

Prohibitive attitudes

Respondents were asked to indicate their agreement (1 = *strongly disagree*, 7 = *strongly agree*) with four statements about car racing on BSF, which included "Car racing should be banned from the Bonneville Salt Flats," and "Car enthusiasts need to stop using the landscape as a specialty race course." These items loaded on one factor and were combined into an attitudinal scale ($\alpha = .87$, $M = 4.44$, SD = 1.48).

Information behavioral intention

The intention to engage in information activities was measured by seven items (1= *very unlikely*, 7 = *very likely*) on information seeking or sharing activities regarding the BSF. Examples included "seek more information about what is going on with the Bonneville Salt Flats;" "seek out more information about how to better preserve the Bonneville Salt Flats;" and "share information on this topic, if I encounter more, with others." Only one factor emerged from these items. We, therefore, aggregated them into one scale of information activities to represent intended behaviors of acquiring or disseminating information on the topic ($\alpha = .94$, $M = 4.16$, SD = 1.52).

Civic participation intention

We asked participants to indicate the likelihood of engaging in each of the four activities related to saving the BSF (1 = *very unlikely*, 7 = *very likely*), including "volunteering for a public education campaign to increase the awareness of the Bonneville Salt Flats," "wearing or displaying a 'Protect the Bonneville Salt Flats' badge or sticker," "signing on a petition for federal funding to protect the Bonneville Salt Flats," and "registering on an email list-serve to receive messages about the Bonneville Salt Flats." The items loaded on one factor, had high internal consistency ($\alpha = .85$), and were averaged into one scale ($M = 3.35$, SD = 1.62).

Analysis strategy

Model testing and comparison

Different conceptual models of blame (depicted in Figure 2) were estimated via structural equation modeling (SEM) on each of the three outcome variables using the "sem" package in Stata 15.1. Model evaluation and comparison were based on two sets of criteria. First, following Kline (2010)'s suggestions, we assessed the fit of each model using the following indices: (1) the model chi-square, (2) the Steiger-Lind root mean square error of approximation (RMSEA, an index sensitive to the number of estimated parameters in the model) (1990), (3) the Bentler comparative fit index (CFI, one of the indices least affected by sample size) (1990), and (4) the standardized root mean square residual (SRMR, capturing the difference between observed and predicted correlations) (Kline, 2010). For a model to be accepted, a RMSEA of .06 (or lower), CFI of .90 (or higher, preferably .95), and SRMR .08 (or lower) are recommended (Hu & Bentler, 1999).

Second, as RQ1 involves comparing non-nested models, we resort to the Bayesian information criteria (BIC) that are appropriate for such model comparisons (Raftery, 1995; Sclove, 1987). We computed the BIC value for each model and calculated the BIC difference between each pair of models being compared. In general, a negative BIC value indicates good model fit, and a positive value suggests a problem with the model. Following the guideline offered in Raftery (1995), differences in BIC values were interpreted as follows using three benchmarks: a difference of 2 in BIC values between the two models provides *some* evidence of a better model (in favor of the one with the lower BIC); a difference of 6 indicates *strong* evidence; and 10 or higher serves as *very strong* evidence.

Control variables

To determine which variables to include as covariates, we first correlated participant's age, gender, race (white vs. others), ideological orientation, and religious guidance with key independent variables and dependent variables. Participant's age, gender, race, and ideological orientation were found to have significant correlations with one or more independent or dependent variables. The partial correlation matrix after controlling for these variables (see Table 1) was estimated in the SEM analyses reported below.

Results

Structure of blame (RQ1a and RQ1b)

First, RQ1a asked whether blame was cognitive (i.e. as responsibility judgment) or affective (i.e. as anger) in nature, or encompassed both aspects.

Table 1. Correlation matrix among variables used in the SEM analyses.

	Certainty manipulation	Perceived certainty	Anger	Responsibility judgment	Information activities	Civic participation	Prohibitive attitudes
Certainty manipulation	1						
Perceived certainty	.196	1					
Anger	−.067	.274	1				
Responsibility judgment	−.037	.371	.321	1			
Information activities	−.053	.175	.410	.386	1		
Civic participation	−.084	.153	.423	.265	.669	1	
Prohibitive attitudes	−.002	.258	.378	.540	.282	.346	1

Notes: $N = 302$. Participant's age, gender, race (white vs. others), and ideological orientation were controlled for.

The Single Process models (Figure 2(a)) postulate that (1) there is no significant path to or from *anger* in the *cognitive* model, *or* (2) there is no significant path to or from *responsibility* in the *affective* model. As they are both subsumed under the Dual Process model (Figure 2(c)), findings from the Dual Process model would show the viability of either Single Process model. Findings from the Dual Process model across all three outcome variables showed significant paths from perceived certainty to anger and to responsibility judgment, as well as significant paths from anger, and from responsibility judgment, to each outcome variable ($p < .001$ for all these paths). Both Single Process models, therefore, were rejected. In response to RQ1a, our data showed that the blame process should comprise both cognitive and affective aspects.

Second, RQ1b inquired about the relationship between the cognitive and affective aspects in capturing blame. There are four possibilities: two Serial Causal models (Figure 2(b)), where (1) anger precedes responsibility judgment, *or* (2) responsibility judgment leads to anger; (3) the Dual Process model where anger and responsibility function as separable, parallel casual pathways, and (4) the Intertwined model where blame is a latent construct of responsibility and anger (Figure 2(d)).

These models were estimated on each of the outcome variables. Model fit and comparison indices are displayed in Table 2. Across all three variables, the Intertwined Model consistently had the best model fit indices. On prohibitive attitudes and information behavioral intention, the BIC differences between the Intertwined model and other competing models were all well above 10, indicating very strong evidence for a better model. On civic participation intention, the BIC differences with other models were clearly advantageous for the Intertwined model (all greater than 10), except for the *responsibility* → *anger* serial causal model. The BIC difference with this model was close to 2, which indicated some, though not strong, evidence for a better model fit of the Intertwined model. Considering all evidence, we conclude that the Intertwined model received the most empirical support.

Table 2. Model fit and comparisons on each of the outcome variables.

Model description	χ^2	df	RMSEA[a]	CFI	SRMR	BIC
DV: Prohibitive Attitudes						
Serial: anger → responsibility	57.78 $p = .000$	5	.187 $p = .000$	.762	.103	29.23
Serial: responsibility → anger	86.60 $p = .000$	5	.232 $p = .000$	.632	.112	58.05
Dual Process	26.68 $p = .000$	4	.137 $p = .002$	.898	.078	3.84
Intertwined	7.94 $p = .094$	4	.057 $p = .348$	.982	.044	−14.90
DV: Information Activities						
Serial: anger → responsibility	72.36 $p = .000$	5	.211 $p = .000$	.625	.113	43.81
Serial: responsibility → anger	43.22 $p = .000$	5	.159 $p = .000$	.787	.085	14.67
Dual Process	26.50 $p = .000$	4	.136 $p = .002$	.875	.079	3.66
Intertwined	9.90 $p = .042$	4	.070 $p = .223$	.967	.051	−12.94
DV: Civic Participation						
Serial: anger → responsibility	82.72 $p = .000$	5	.227 $p = .000$	.526	.121	54.17
Serial: responsibility → anger	24.60 $p = .000$	5	.114 $p = .008$	.881	.070	−3.95
Dual Process	27.79 $p = .000$	4	.139 $p = .001$	.857	.080	4.95
Intertwined	17.16 $p = .002$	4	.104 $p = .032$	.920	.061	−5.68

Notes: RMSEA: Root mean square error of approximation; CFI: Comparative fit index; SRMR: standardized root mean square residual; BIC: Bayesian information criterion, computed as $\chi^2 - Ln(N)*df$ where χ^2 is the minimum function chi-square.
[a] *p*-value refers to the probability of RMSEA ≤ .05.

Therefore, in answer to RQ1b, evidence across all three outcome variables suggested that blame should be best conceptualized as a latent construct consisting in both cognitive and affective components (i.e. responsibility judgment and anger). Figure 3 depicts the standardized coefficients for the Intertwined models for each of the three outcome variables.

Certainty, blame, and environmental engagement

After confirming the structure of blame, an integrated model was fit where blame as the latent construct was a mediator, and all three outcome variables were included at the same time. The model had a satisfactory fit: $\chi^2(9) = 31.26$ ($p = .001$), RMSEA = .090 ($p_{RMSEA<.05} = .025$), CFI = .956, SRMR = .059.[7] Standardized path coefficients are displayed in Figure 4. Indirect and total effects for all possible pathways are reported in Table 3.

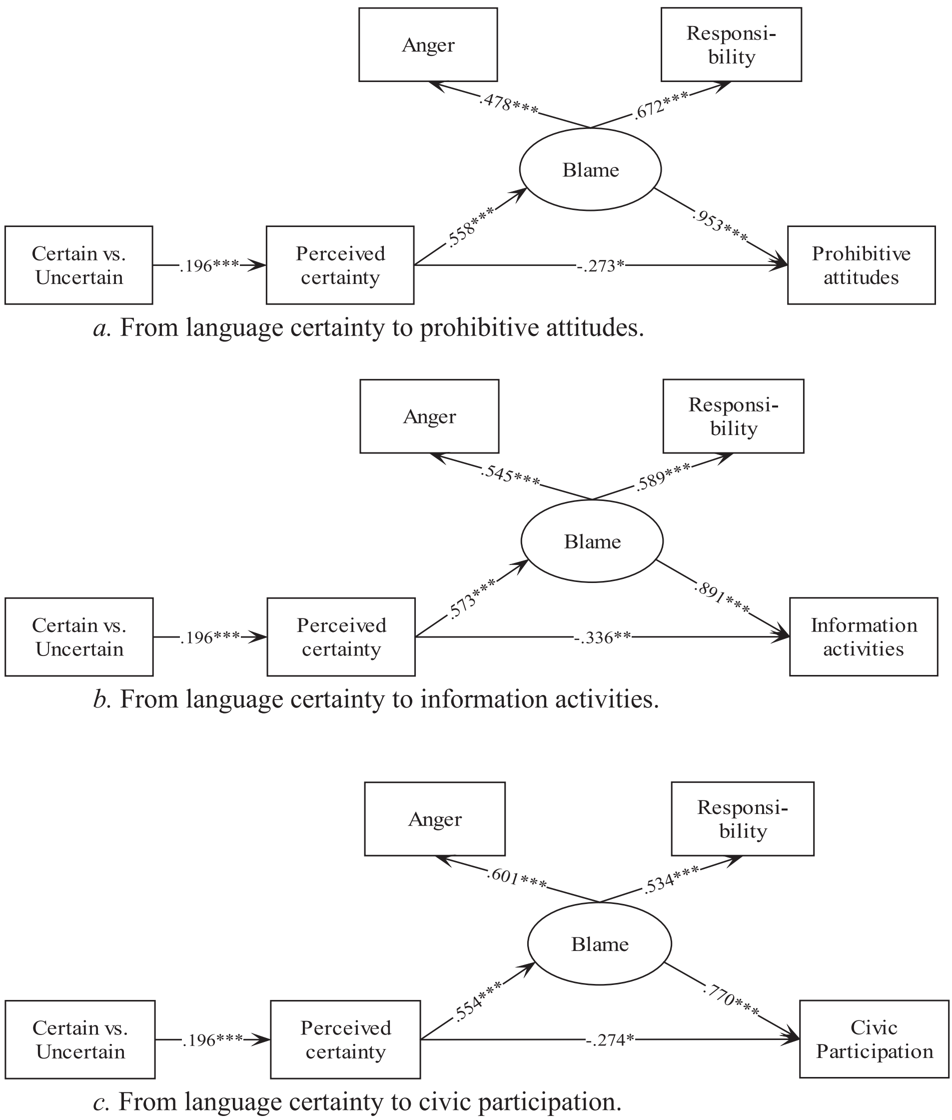


Figure 3. Effects of language certainty on the attitudinal/behavioral outcomes from the intertwined model of blame. (a) From language certainty to prohibitive attitudes. (b) From language certainty to information activities. (c) From language certainty to civic participation. Notes: Standardized coefficients were depicted in the figure. *$p < .05$, **$p < .01$, ***$p < .001$.

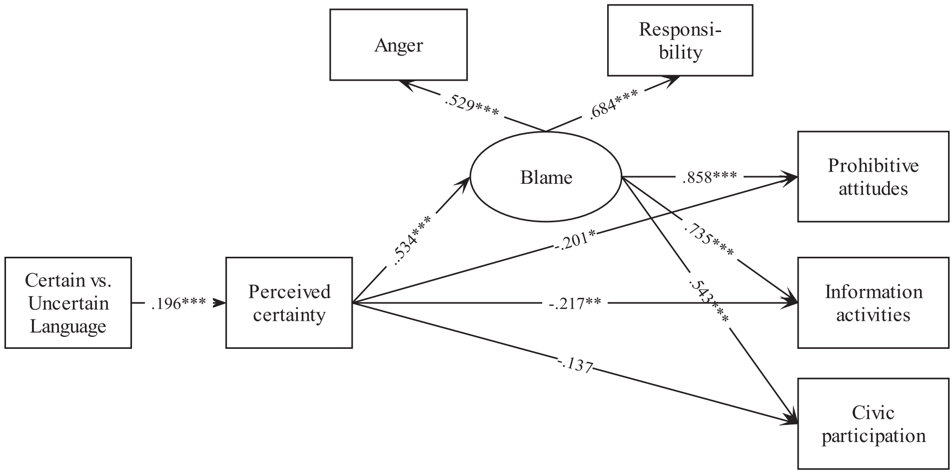


Figure 4. Blame as the mediating factor of attitudinal and behavioral outcomes: The overall model.

Notes. $N = 302$. *$p < .05$, **$p < .01$, ***$p < .001$. Standardized coefficients were depicted in the figure. Correlated errors between civic participation and information activities, and punitive attitudes and information activities, are not depicted in the figure. $\chi^2(9) = 31.26$, $p = .001$, RMSEA = .090 ($p_{RMSEA<.05} = .025$), CFI = .956, SRMR = .059. BIC = −20.13. RMSEA: Root mean square error of approximation; CFI: Comparative fit index; SRMR: standardized root mean square residual.

As can been seen in Figure 4, language certainty was a significant positive predictor of perceived certainty ($\beta = .196$, $p < .001$), supporting H1, and perceived certainty was significantly related to blame as a latent factor ($\beta = .534$, $p < .001$) in support of H2. Blame was a significant predictor of all three outcomes: prohibitive attitudes ($\beta = .858$, $p < .001$),[8] informational behavioral intention ($\beta = .735$, $p < .001$), and civic participation intention ($\beta = .543$, $p < .001$). H3 was supported. From Table 3, the indirect effects of perceived certainty on all three outcome variables via blame were all significant ($\beta = .459$, .391, .290, respectively, $p < .001$ for all), supporting the mediating effect hypothesized in H4. In addition, the total effects from perceived certainty on these outcomes were also significant, suggesting that the positive indirect effects through blame outweighed the residual negative direct effects as depicted in Figure 4.

Discussion

Whether blame is “a cognitive–affective blend” inseparable from responsibility and anger is a question “amenable to empirical resolution” (Weiner, 1995, pp. 15–16). Our study offers an effort toward such a resolution. In comparing different models of the structure of blame, the evidence converged to support the Intertwined model, where blame was a latent construct consisting of

Table 3. Indirect and total effects from certainty and perceived certainty to blame and outcome variables.

	Blame	Prohibitive attitudes	Information activities	Civic participation
Certainty Manipulation	.056**	.051**	.034*	.030*
Indirect effects	(.018)	(.018)	(.015)	(.021)
Perceived Certainty	–	. 459***	.391***	.290***
Indirect effects		(.083)	(.078)	(.059)
Perceived Certainty	.283***	.258***	.175**	.153**
Total effects	(.044)	(.056)	(.056)	(.057)

Notes: Standard coefficients were reported with corresponding standard errors in the parentheses. Results were based on the overall model depicted in Figure 4.
*$p < .05$.
**$p < .01$.
***$p < .001$.

both responsibility judgment and anger. In other words, as is conceptualized in Weiner (1995, Figure 1), blame is a blend of the cognitive belief of responsibility and the affective experience of anger. Our conceptual and empirical effort to differentiate blame from related concepts represents a contribution to the extant literature: such differentiation is a needed "scientific task … allowing us to make fine-grained predictions that collapsed constructs do not permit" (Malle, Monroe, et al., 2014, p. 252).

As such a construct, blame functioned as a psychological mediator between exposure to an environmental message and subsequent social responses in our study. Our findings showed that elicited blame was a motivating force to correct the perceived violations and improve the situation. Such corrective actions included not only the punitive attitude against the wrongdoing but also intentions to engage in proactive measures such as issue-related information seeking and sharing and civic participatory behaviors. Our findings about the nature and social functions of blame offer an account of how media coverage on social issues, often a site of contestation over what or who to "blame," could influence the public's perceptions and actions in the issue arena. These findings are consistent with previous research on blame frames in the context of political communication (Hameleers et al., 2018). We also suggest that future studies on blame incorporate the measurement structure of blame as is demonstrated in our study.

This study examined how using certain vs. uncertain language to communicate scientific findings to the public may arouse different levels of blame. Increased certainty of the causal link between the perceived agent and the negative event generated stronger blame, consistent with the previous literature on the relationship between causality and blame (Alicke, 2000; Malle, Monroe, et al., 2014). As Alicke (2014, p. 189) emphasized, blame is malleable to new evidence or information for consideration and as such, is "a working hypothesis." The message stimulus used in our study chose to feature the information of land-speed racers as possibly responsible for the decline of the BSF, but we hasten to add that it should not mean that we regarded them as a definitive party to blame, especially given the lack of conclusive evidence in the current scientific research. The goal of our study was to underpin the psychological process of blame using the BSF decline as a context for the focal inquiry, not to make a statement of who to blame for the BSF decline.

Limitations

This study raises issues and has limitations worthy of further discussion. First, the residual direct effects from perceived certainty were negative on all three outcome variables (statistically significant for two). It suggests the presence of unexamined mechanisms at work that could have dampened the effect of perceived certainty on the public's issue engagement. One possibility is that language certainty may reduce trust in the scientists or the research findings (Jensen, 2008), which could negatively impact motivation to engage in pro-environmental actions. The use of certain vs. uncertain language, thus perceived as suggesting a stronger advocacy, may also inadvertently activate reactance among the readers and disincline them from further issue engagement. A higher level of perceived certainty about the BSF decline could also potentially generate pessimism about its prospect and thus a sense of futility of engaging the issue. These are only our speculations, however, as we do not have data to test these possible explanations.

Another issue with the study is the measurement of anger. In our study, anger was measured as the participant's emotional experience during the message exposure. We did not, however, ask specifically about the target of anger. The lack of such specification left the possibility that the reported experience of anger could include other sources beyond the blamed party. Future research on blame should incorporate measures of anger that specify its source or target so as to differentiate anger as part of blame from anger triggered by other factors (e.g. the issue stance or the composition or delivery of the message, etc.).

There are other limitations to this study. An obvious one is the use of a college student sample, which limits the generalizability of our findings. Future studies should use more representative samples to replicate the findings and assess their generalizability. Without downplaying this limitation, we also wish to note that the college student sample, given the context of the study, was a local group that could relate more to the featured environmental problem. In general, college students are also a segment of the population with growing environmental awareness and political sensitivity. Thus, findings from such a sample also yield relevant and useful insights for studies of environmental communication.

Another weakness of the study is the single message design, where a message category is represented by only one concrete example. Multiple-message designs are the preferred strategy to address the issue of generalizability across messages more efficiently (O'Keefe, 2015; Reeves et al., 2016). Whether or not the structure of blame, as substantiated in this study, would replicate in other issue contexts is a question awaiting future research. In addition, despite our best effort to keep other message elements constant across different conditions, there could be extraneous influences of certain message elements in unknown ways, which would be better controlled for with multiple message replications. Future research should also consider issue characteristics and their potential interplay of message features, which could influence the experience of blame and subsequent social responses. For instance, the persistence and/or the reversibility of an environmental issue could affect responsibility attributions and associated judgments (Weiner et al., 1988). Different issues may also be more or less relevant to certain segments of the population, thus making issue involvement an important moderator worthy of investigation. In sum, it is important for future studies to include multiple messages to enable more robust examinations of the focal theoretical factors and ensure the generalizability of the findings across message topics.

On communicating scientific uncertainty and future research

Existing research on communicating scientific uncertainty has been mostly concerned with the public's perceptions of the scientific issue or researchers (Corbett & Durfee, 2004; Jensen, 2008). Our study took a step further and examined the relationships between perceptions of scientific certainty and behavioral intentions of issue engagement. The significant total effects of perceived scientific certainty on attitudes and behavioral intentions suggested that increased perceptions of certainty could better mobilize the public to partake in environmental protection. Or, equivalently, when the public were less sure about human causes of environmental problems, they would be less likely to take collective actions to address such problems. How to communicate scientific uncertainty without discouraging public engagement, therefore, is worth pondering for this line of research. We hope our findings will inspire future research to investigate the possible behavioral consequences of communicating scientific uncertainty. How to best communicate uncertainty of scientific findings to both optimize the accuracy of the public's understanding and maximize their issue engagement is a complex yet intriguing question for researchers of science and environmental communication.

Notes

1. Although in everyday language we can also say "We blame the rain for the delay," we only consider blame as arising from events caused by human agents.
2. In the blame literature, responsibility mostly refers to moral accountability, as opposed to legal responsibility (see Shaver, 2012).
3. Project funded by National Science Foundation: *Adaptation, Mitigation, and Biophysical Feedbacks in the Changing Bonneville Salt Flats: NSF Coupled Natural Human Systems*, Principal Investigator: Brenda Bowen, University of Utah, 2016–2020.
4. The experimental study involved other two factors: positive images (yes vs. no), and inclusion of negative images (yes vs. no). These two factors were included for questions not addressed in this paper and were shown to have no effects on the variables examined in this study. We analyzed the effects of the three factors (all the 3-way and 2-way interactions and main effects) on all the endogenous variables used in the SEM analyses reported in this study: perceived certainty, anger, responsibility attribution, information activities, civic

participation, and prohibitive attitudes. On each variable, we conducted a MANOVA to examine the multivariate effects, followed by univariate analyses. From these analyses, the only significant effects were the main effect of certainty vs. uncertainty manipulation. None of interaction effects or the other main efforts were significant. We therefore proceeded by only analyzing the language certainty as the experimental factor.

Given the design, the required sample size was estimated via G*Power for a power of .80 at two effect sizes, $f = .15$ and $f = .20$, picked between the small ($f = .10$) and medium ($f = .25$) effect sizes. The estimated required sample size was $n = 199$ for $f = .20$ and $n = 351$ for $f = .15$.

5. To add degrees of freedom to the model for model comparison, certainty manipulation was put as an exogenous variable leading to either two latent factors consisting of two items each, or one latent factor with four items. The two-factor model showed a poor fit: $\chi^2(4) = 84.13$, $p < .001$, RMSEA = .255, CFI= .780, SRMR= .167. One factor model was a better fit: $\chi^2(5) = 33.42$, $p < .001$, RMSEA = .136, CFI = .922, SRMR = .050. Including correlated error between the two items of scientific evidence being conclusive or established further improved the fit of the one-factor model: $\chi^2(5) = .59$, $p = .96$, RMSEA = .000, CFI = 1.00, SRMR = .007.
6. To reduce demand characteristics, these three items were embedded in a randomized list with other emotions such as sad, surprise, happy, depressed. To ascertain that the item "disgusted" belonged to the same scale as "angry" and "outraged," we ran confirmatory factor analyses (CFA). Since there were only three items in this theorized scale (hence a just-identified model), we introduced two additional emotional measures, "sad" and "depressed," to construct models for comparison. One measurement model had two factors: anger ("angry," "outraged," "disgusted") vs. sadness ("sad," "depressed"). The competing model contained three factors: anger ("angry," "outraged"), disgust ("disgusted"), and sadness ("sad," "depressed"). As the two models were not nested, the BIC difference was used to assess model comparison. The two-factor model (BIC = −18.39) was shown to be a superior model than the three-factor model (where "disgusted" was its own factor, BIC = −7.28). This BIC difference (11.11) is regarded as strong evidence in favor of the two-factor model. Hence, the CFA results demonstrated that "disgusted," "angry," and "outraged" formed one factor.
7. The competing models in Figure 2 were tested as well though not reported here. The BIC value for the integrated model with blame as a latent construct was −20.13. The BIC difference was 17.54 against the Dual Process model, and above 80 for the two serial causal models. Again, the evidence strongly favored the intertwined model of blame.
8. This rather high coefficient bespeaks the potential lack of discriminant validity; the operationalization of punitive attitudes needs to be refined in future research.

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Appendix

Message stimulus (certainty condition)

Decline – The Salt Flats in Danger

The size and quality of this sublime landscape have declined, however, over the past 30 years according to data by a team of scientists at the University of Utah. Satellite imagery analyzed by University of Utah researchers demonstrates a decades-long trend of decline.

"On geologic time scales, this part of the world is changing rapidly," says Mary Smith, a geologist at the University of Utah, "a result of a combination of natural and anthropogenic — human-caused — forces."

"To think that one part of the land use isn't having an impact is overlooking the complexity of the system," she said. Human interactions with the iconic landscape — including the land speed racing for which the flats are internationally known — are responsible for the changes.

Smith's first paper is expected out this fall. From the data she collects, Smith said, she's convinced human activity is changing the landscape. Based on her two years of research, she thinks that the ecosystem is more sensitive to human interactions than previously assumed.

Smith also believes that natural processes, as well as climate change, are affecting the Salt Flats.

Message stimulus (uncertainty condition)

Decline - An Uncertain Future

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"To think that one part of the land use isn't having an impact is overlooking the complexity of the system," she said. Human interactions with the iconic landscape — including the land speed racing for which the flats are internationally known — may be responsible for the changes.

Smith's research still is incomplete — her first paper is expected out this fall. But the more data she collects, Smith said, the more she's convinced human activity is changing the landscape. Her two years of research leads her to think that the ecosystem is more sensitive to human interactions than previously assumed.

Smith said she also believes that natural processes, as well as climate change, are affecting the Salt Flats. Smith emphasizes that at this point the data are too inconclusive to understand what is happening. She expects years of further research are needed.