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Abstract
Building on research in motivated reasoning and framing in science communication, we examine how messages that vary attribution of responsibility (human vs animal) and temporal orientation (now vs in the next 10 years) for wildlife disease risk influence individuals' conservation intentions. We conducted a randomized experiment with a nationally representative sample of US adults ($N = 355$), which revealed that for people low in biospheric concern, messages that highlighted both human responsibility for and the imminent nature of the risk failed to enhance conservation intentions compared with messages highlighting animal responsibility. However, when messages highlighting human responsibility placed the risk in a temporally distal frame, conservation intentions increased among people low in biospheric concern. We assess the underlying mechanism of this effect and discuss the value of temporal framing in overcoming motivated skepticism to improve science communication.

Keywords
attribution of responsibility, biospheric concern, framing, One Health, pro-environmental behavior, science communication, temporal distance

Increasingly, medical, veterinary, and environmental health communities have adopted a "One Health" approach, which emphasizes the interdependence of the health and well-being of humans, animals, and their environments (Rabinowitz et al., 2008; Rock et al., 2009). Efforts to communicate about One Health seek to raise public awareness about the shared human responsibility for the

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production of myriad risks, such as how destruction of natural habitat may give rise to the prevalence of wildlife disease, and even mobilize support for conservation or pro-environmental action to reduce such risks (Keesing et al., 2010; Singer, 2009). Moreover, by monitoring disease risks and urging publics to take action, advocates of One Health, including state and federal agencies, often characterize such risks as imminent (e.g. Chronic Wasting Disease Alliance, 2014; National Park Service (NPS), 2014). Presumably, scientists and environmental advocates believe that highlighting the serious and imminent nature of the risk and its relationship to human behavior can motivate citizens to take immediate, corrective action. Little is known, however, about public acceptance of One Health messages about imminent wildlife disease risks. Furthermore, a growing literature in the behavioral sciences challenges such intuition and provides a basis for further empirical study.

1. Theories and Rationales

Motivated reasoning and the public acceptance of One Health messages

Although One Health's approach has gained wide recognition within the scientific community—including the American Medical Association, the American Association of Wildlife Veterinarians, and the Wildlife Disease Association (Conrad et al., 2009; Zinsstag et al., 2006)—public acceptance of the "shared risk" and shared responsibility tenets of the approach is less apparent. Wildlife species are often construed as threats to the health of companion animals and humans, and media coverage about rabies, Lyme disease, West Nile virus, and chronic wasting disease (CWD) tend to blame animals for the proliferation of such zoonotic or wildlife diseases (Cassidy and Mills, 2012; Decker et al., 2011). Moreover, extant science communication literature suggests that even when public information emphasizes human responsibility for an environmental risk, public acceptance of the message and prescribed pro-environmental behavior may not be forthcoming (Nisbet et al., 2015). Rather, research in motivated evaluation of scientific evidence suggests that long-held environmental attitudes often overwhelm situational information cues (Kahan, 2013; Van Der Werff et al., 2013). Indeed, research on motivated reasoning suggests that when presented with information that contradicts their preexisting beliefs, individuals may selectively attend toward evidence that supports their point of views and less to evidence that threatens them (e.g. Kahan, 2013). Then, simply highlighting the human role in preventing or responding to wildlife disease risk may be insufficient to encourage attitudinal or behavioral shifts among those who already express less concern for wildlife and the environment. Thus, we arrive at the central question motivating this research: how do we craft One Health messages about wildlife disease risk to encourage conservation intentions among a broad audience, including people most likely to reject these messages, such as those low in biospheric concern?

Temporal framing and overcoming motivated reasoning of One Health messages

In the current research, we focus on whether modifying the temporal proximity of the risk might overcome expected motivated reasoning among individuals low in biospheric concern. Given the pressing nature of many conservation challenges, it is common for One Health messages to place the disease risk in temporal context, describing it as happening *now* or sometime *in the future* (e.g. Chronic Wasting Disease Alliance, 2014; NPS, 2014). Although practitioners tend to assume that highlighting the imminent nature of the risk encourages pro-environmental action—in part because proximal threats may be perceived as more threatening than distal ones (e.g. Zwickle and Wilson,

2014)—we predict the opposite might occur. In particular, we hypothesize that situating the risks in the relatively distant future—especially with an emphasis on human responsibility—may be more effective in bolstering conservation intentions by reducing motivated reasoning among those low in biospheric concern.

Two sets of findings support this idea. First, research on dual modes of information processing indicates that temporally proximal events tend to be processed by more effortful means that are more likely to activate reasoning based on one's prior beliefs (Kahan, 2013; McElroy and Mascari, 2007). In comparison, temporally distal events are processed by less effortful means, thus deactivating the motivated skeptical processing of information (Roh et al., 2015). Second, literature on construal level theory similarly suggests that temporally proximal events tend to be construed in a concrete manner, which strengthens processing of information based on initial beliefs (Luguri and Napier, 2013); conversely, temporally distal events are more likely to be processed in an abstract manner, in which one can be more tolerant of information violating initial beliefs (Yang et al., 2012).

Building on these ideas, we suggest that when a message highlights human responsibility for an emergent wildlife disease risk—that is, countering the beliefs of those low in biospheric concern—presenting the risk as imminent (i.e. temporally proximal) will not increase conservation intentions among this group. In contrast, messages that highlight human responsibility and present the risk as temporally distant will decrease resistance to the idea of human responsibility and, in turn, increase conservation intentions. Given the more crystallized pro-environmental beliefs among those who are relatively high in biospheric concern, we also expect these individuals will be less susceptible to such framing effects (McComas et al., 2015).

2. Methods

Participants

A random sample of 700 panelists were contacted from a national panel of US adults provided by GfK (www.gfk.com) via random digit dialing and asked to participate in a web-based, randomized experiment conducted between 8 November and 12 December 2012. A total of 355 did so, resulting in a completion rate of 50.8%, commensurate with the completion rate of randomized experiments using the GfK panel.[1]

Procedure

The study featured a 2 (attribution of responsibility: human vs animal) × 2 (temporal distance: proximal vs distal) design including a fifth, no-exposure control group. As no a priori template exists for communicating about environmental risk using a One Health frame, we operationalized the concept as emphasizing not only wildlife and environmental factors but also possible human factors that contribute to the presence of CWD and labeled this as the *human responsibility* frame condition. In contrast, the *animal responsibility* frame attributed responsibility for the presence of CWD primarily to wildlife behavior or natural variation without specifying a clear human role. The animal responsibility condition enabled us to isolate the effects of attribution of responsibility since mere comparison between the human responsibility and no message conditions cannot tell us whether the attribution cue influences conservation intentions for those low in biospheric concern. Including the animal responsibility condition also allowed us to rule out an alternative account, which was that the message condition simply raised awareness of CWD. In addition, we varied the temporal frame of the message by describing CWD as a major problem affecting wildlife health

"today" (in the *proximal* condition) or "in the next ten years" (in the *distal* condition). The full text of the messages, which were developed in consultation with experts in wildlife veterinary medicine to ensure their scientific accuracy, appears in the Supplementary material (pus.sagepub.com).

After reading the message, participants answered questions about conservation intentions and biospheric concern. Participants randomly assigned to the control condition advanced directly to the questionnaire without reading a message. Since the goal of this work is to test the efficacy of One Health messages by differing attribution of responsibility and temporal frames, we compare the four experimental conditions and will not discuss the control condition further. This study was exempt by the institutional review board of S.R.'s home institution at the time (protocol number: 1206003133).

Measures

Dependent measure: Conservation intentions. We adapted the key dependent measure, conservation intentions, from prior work (Halpenny, 2010).[2] Specifically, respondents were asked whether they were 1 = very likely to 6 = very unlikely to engage in each of eight behaviors with respect to parks or natural areas in the next 3 months, including volunteering to stop visiting a favorite spot in a park or natural area if it needs to recover from environmental damage, participating in a public meeting, signing petitions, and contributing donations. We reverse coded and established a mean scale with these eight items, with higher values indicating greater intentions to engage in conservation behaviors ($\alpha = .90$; $M = 3.24$, standard deviation (SD) = 1.18).

Moderator: Biospheric concern. To measure biospheric concern, we asked respondents to rate their concern for environmental problems in the avian, plant, animal, and marine life realms, using a scale of 0 = not at all concerned to 5 = extremely concerned (Schultz, 2001).[3] We established a mean scale with these four items, with higher values indicating greater concern ($\alpha = .93$; $M = 3.35$, $SD = 1.21$).

Demographics and controls. Table 1 shows the demographic characteristics of the study sample. Since biospheric concern was not manipulated and was also correlated with various demographic characteristics, we collected demographic data such as age, gender, level of education, race or ethnicity, geographical region, political partisanship, and experience with CWD (i.e. if respondents had ever heard of the disease) to use in the regression model as covariates.

Manipulation check. To ensure that the framing of responsibility manipulation worked as intended, we compared responses to the question that asked "Which one of following should be blamed for CWD? Please use the scale below to indicate the total percentage of blame each group or factor should be given for CWD (Total must sum to 100)." With three scores rated for humans, animals, and the environment (the order of the three groups was randomized), we calculated an index denoting the ratio of human-to-animal blame.[4] Respondents rated more blame on humans in the human versus the animal responsibility condition, $t = -2.746$, $df = 267$, $p < .007$, $d = .34$ ($M_{\text{Animal}} = .24$, $M_{\text{Human}} = .42$), suggesting the manipulation was successful.

Mediator: Who is to blame for the prevalence of CWD. The manipulation check items, the relative blaming of human versus animal, may be a promising mediating variable illuminating resistance to a One Health message's core argument. Based on biased processing, we would expect that this measure could tap into rejection of the human responsibility frame, a signal of resistance. Thus, we examined the likelihood of blaming humans more than animals for CWD as a mediator.

Table 1. Demographics of study participants ($N = 355$).

	Sample	Test for differences by condition
	Proportion (*n*); *M* (*SD*)	χ^2/*p* value; *F*/*p* value
Randomized experimental condition		
No message exposure (control) group	0.20 (71)	
Human responsibility with temporally *proximal* frame	0.24 (84)	
Human responsibility with temporally *distal* frame	0.18 (63)	
Animal responsibility with temporally *proximal* frame	0.22 (79)	
Animal responsibility with temporally *distal* frame	0.16 (58)	
Female	0.51 (181)	$\chi^2(4) = .78$, $p = .94$
Age (mean)	50.07 (16.96)	$F(4, 350) = .60$, $p = .66$
Ideology (Liberal–Conservative Scale, 1–7)	4.14 (1.47)	$F(4, 341) = .59$, $p = .67$
Highest level of education completed		
Less than high school diploma	0.10 (36)	$\chi^2(12) = 10.83$, $p = .54$
High school diploma or equivalent	0.30 (108)	
Some college	0.32 (112)	
Bachelor's degree or higher	0.28 (99)	
Regions		
Northeastern region	0.16 (58)	$\chi^2(12) = 8.49$, $p = .75$
Midwestern region	0.23 (82)	
Western region	0.25 (89)	
Southern region	0.35 (126)	
Political party leanings		
Republican	0.43 (152)	$\chi^2(8) = 3.82$, $p = .87$
Democrat	0.52 (184)	
No Leaning	0.05 (19)	
Race or ethnicity		
White, non-Hispanic	0.74 (261)	$\chi^2(16) = 7.77$, $p = .96$
Black, non-Hispanic	0.10 (35)	
Other, non-Hispanic	0.03 (9)	
Hispanic	0.12 (42)	
2+ races, non-Hispanic	0.02 (8)	
Ever heard about chronic wasting disease	0.19 (69)	$\chi^2(4) = 2.82$, $p = .59$

SD: standard deviation.
All sample characteristics are proportions with sample sizes in parentheses, except for age and ideology, which are means (SDs in parentheses).

3. Results

Main effects of messages

Before turning to our main analysis, we explore main effects of the messages using analysis of variance (ANOVA) and ordinary least squares (OLS) regression. A comparison of mean values for support for conservation intentions showed no significant differences across the four message

conditions ($F<1$, *nonsignificant*). Overall, the mean values for conservation intentions were below the scale's midpoint (3.5) across conditions ($M_{\text{Human Responsibility–Temporally Proximal}}=3.23$, $M_{\text{Animal Responsibility–Temporally Proximal}}=3.35$, $M_{\text{Human Responsibility–Temporally Distal}}=3.36$, $M_{\text{Animal Responsibility–Temporally Distal}}=3.18$). In addition, the level of conservation intentions in the control condition did not differ significantly from that observed in any of the message conditions ($ps>.18$).

Effects on conservation intentions

Using OLS regression, we regressed conservation intentions onto our message conditions (using the human responsibility and temporally proximal condition as the referent group), biospheric concern, and all second-order interaction terms. This model yielded several findings. First, highlighting human responsibility for the prevalence of CWD and presenting it as a proximal risk did not alter conservation intentions compared with messages highlighting animal responsibility (with either a temporally proximal or distal frame) regardless of participants' levels of biospheric concern, as the interaction terms were nonsignificant, $|t|s<1.06$, $ps>.29$. Second, and more importantly, there was a significant interaction between the message combining human responsibility with temporally distal frame and biospheric concern, $b=-.34$, $t(291)=-2.59$, $p=.01$ (Model 1 of Table 2).[5]

We probed the interaction using techniques prescribed by Aiken and West (1991). This analysis revealed that when human responsibility was presented with a temporally distal (vs proximal) frame, conservation intentions among participants who reported relatively lower biospheric concern (operationalized as $M-1SD$) were significantly enhanced, $b=-.55$, $t=-2.13$, $p=.03$. This message effect was not observed among participants high in biospheric concern ($M+1SD$), $t<1$, $p=.36$ (Figure 1).

Effects on who is to blame for the prevalence of CWD

Analysis next turned to a potential mediating variable: the extent to which respondents blamed human actions over animal behavior for the prevalence of CWD. Using a logistic regression model, we regressed the likelihood of blaming humans more than animals (two-category nominal outcome: blaming humans more than animals = 1; blaming humans and animals equally or blaming animals more than humans for the prevalence of CWD = 0) onto our message conditions combining attribution of responsibility and temporal distance (again, using the human responsibility and temporally proximal message as the referent group), biospheric concern, and all second-order interaction terms.

Analogous to the results from the previous analyses of conservation intentions, the results showed that emphasizing human responsibility and temporal proximity does not change the likelihood of blaming humans more than animals for the prevalence of CWD regardless of participants' levels of biospheric concern, as the interaction terms were nonsignificant, $|t|s<1.30$, $ps>.19$. The results suggested that only the interaction between the human responsibility, temporally distal message, and biospheric concern was significant, odds ratio (OR) = .40, $z=-2.10$, $p=.04$ (Model 2 of Table 2). Probing this interaction, further analysis revealed a borderline statistical difference such that emphasizing human responsibility while describing CWD as a distal (vs proximal) risk increased the likelihood that participants expressing a relatively lower level ($M-1SD$) of biospheric concern now appeared to blame humans more than animals for the prevalence of CWD, $b=-.26$, $z=-1.93$, $p=.053$, ($M_{\text{Proximal}}=36.2\%$, $M_{\text{Distal}}=62.5\%$). We did not observe this differential impact between the messages for participants with relatively higher levels ($M+1SD$) of biospheric concern, $b=.10$, $z=1.43$, $p=.15$ (Figure 2).

Table 2. Regression models testing interactions between combinations of attribution and temporal frames and biospheric concern.

	Model 1: OLS regression predicting conservation intentions		Model 2: logistic regression predicting blaming humans more than animals		Model 3: OLS regression predicting conservation intentions: mediated moderation model	
	b (*SE*)	*t*	OR (95% CI)	*z*	*b* (*SE*)	*t*
Key variables						
Animal responsibility and temporally proximal frame (reference = human responsibility and temporally proximal frame)	0.54 (0.51)	1.05	3.89 (0.91–81.30)	0.87	0.31 (0.57)	0.55
Animal responsibility and temporally distal frame (reference = human responsibility and temporally distal frame)	0.56 (0.54)	1.03	3.11 (0.15–63.28)	0.74	0.38 (0.67)	0.56
Human responsibility and temporally distal frame (reference = human responsibility and temporally distal frame)	1.33 (0.47)	2.83**	24.37 (1.30–457.39)	2.13*	0.67 (0.62)	1.08
Biospheric concern	0.51 (0.08)	6.71***	3.80 (1.94–7.42)	3.90***	0.50 (0.13)	3.83***
Animal responsibility and temporally proximal frame × biospheric concern	−0.12 (0.15)	−0.84	0.66 (0.26–1.68)	−0.86	−0.09 (0.16)	−0.52
Animal responsibility and temporally distal frame × biospheric concern	−0.16 (0.15)	−1.06	0.56 (0.23–1.34)	−1.30	−0.11 (0.18)	−0.62
Human responsibility and temporally distal frame × biospheric concern	−0.34 (0.13)	−2.59*	0.40 (0.17–0.94)	−2.10*	−0.18 (0.17)	−1.07
Blaming humans more than animals					0.93 (0.47)	1.98*
Blaming humans more than animals × biospheric concern					−0.19 (0.13)	−1.41
Controls						
Female (reference = male)	0.16 (0.13)	1.31	0.79 (0.42–1.48)	−0.73	0.17 (0.14)	1.19
Age	0.01 (0.00)	1.84	1.00 (0.98–1.02)	−0.13	0.01 (0.00)	1.26
Less than high school (reference = college graduate)	0.21 (0.22)	1.11	0.25 (0.08–0.78)	−2.38**	0.27 (0.27)	1.01
High school diploma (reference = college graduate)	−0.01 (0.16)	−0.03	0.56 (0.25–1.26)	−1.39	−0.05 (0.18)	−0.25
Completed some college (reference = college graduate)	0.17 (0.16)	1.08	0.58 (0.26–1.33)	−1.29	0.24 (0.19)	1.30
Northeast (reference = South)	−0.26 (0.18)	−1.40	0.81 (0.33–2.00)	−0.45	−0.07 (0.21)	−0.32
Midwest (reference = South)	−0.10 (0.17)	−0.58	0.68 (0.30–1.54)	−0.93	0.09 (0.19)	0.44
West (reference = South)	−0.02 (0.16)	−0.12	3.06 (1.25–7.52)	2.44*	0.13 (0.19)	0.68
White (ref = other race)	−0.22 (0.16)	−1.36	1.79 (0.79–4.07)	1.39	−0.22 (0.19)	−1.19
Republicans (reference = democrats)	−0.05 (0.13)	0.41	1.23 (0.64–2.37)	0.61	−0.09 (0.15)	−0.58
Heard about chronic wasting disease	0.19 (0.16)	1.18	0.46 (0.22–0.98)	−2.01*	0.14 (0.18)	0.78
Constant	1.15 (0.37)	3.10**	0.04 (0.00–0.40)	−2.69**	1.14 (0.51)	2.24*
% Explained R^2	23.4%		20.1%		21.5%	
Number of observations	310		251		235	

OLS: ordinary least squares; *SE*: standard error; OR: odds ratio; CI: confidence interval.
*$p < .05$, **$p < .01$, ***$p < .001$.

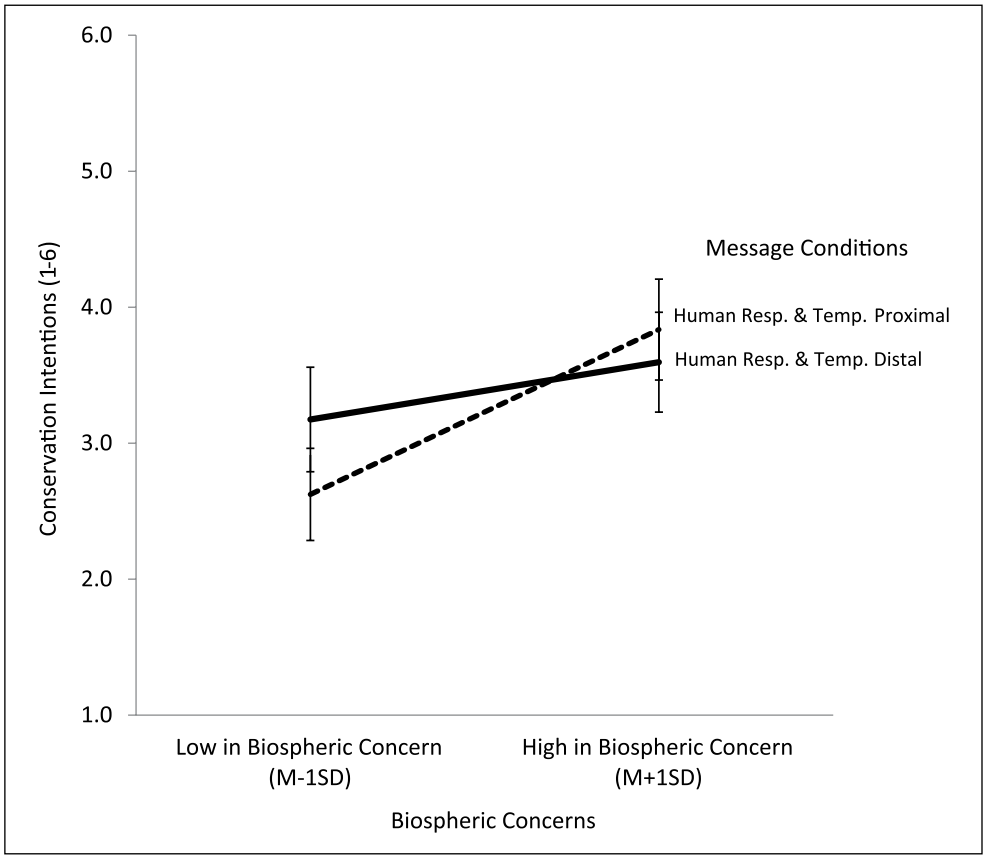

Figure 1. Graph depicting the interaction between message conditions and biospheric concern on conservation intentions.
Error bars represent 95% confidence intervals around the predicted mean of the item.

Mediated moderation

Given the significant correlation between conservation intentions and the likelihood of blaming humans more than animals for the prevalence of CWD ($r = .22$, $p < .001$), we conducted further analysis to examine whether the likelihood of blaming humans more than animals mediated the observed relationships between the message frames, biospheric concerns, and conservation intentions. To establish this mediated moderation, we employed procedures described by Muller et al. (2005).

As with the OLS regression, participants' biospheric concern moderated the message's effect on conservation intentions (Model 1 of Table 2). We also found an analogous finding on the likelihood of blaming humans more than animals (Model 2 of Table 2). Furthermore, we found a partial effect of the likelihood of blaming humans more than animals (the proposed mediator) on conservation intentions, $b = .93$, $t = 1.98$, $p < .05$ (Model 3 of Table 2). Finally, when we accounted for blame and its interaction with biospheric concern, the residual direct effects of the message were no longer moderated by biospheric concern (Model 3 of Table 2 again). The coefficient of the human responsibility with temporally distal (vs temporally proximal) message condition and biospheric concern

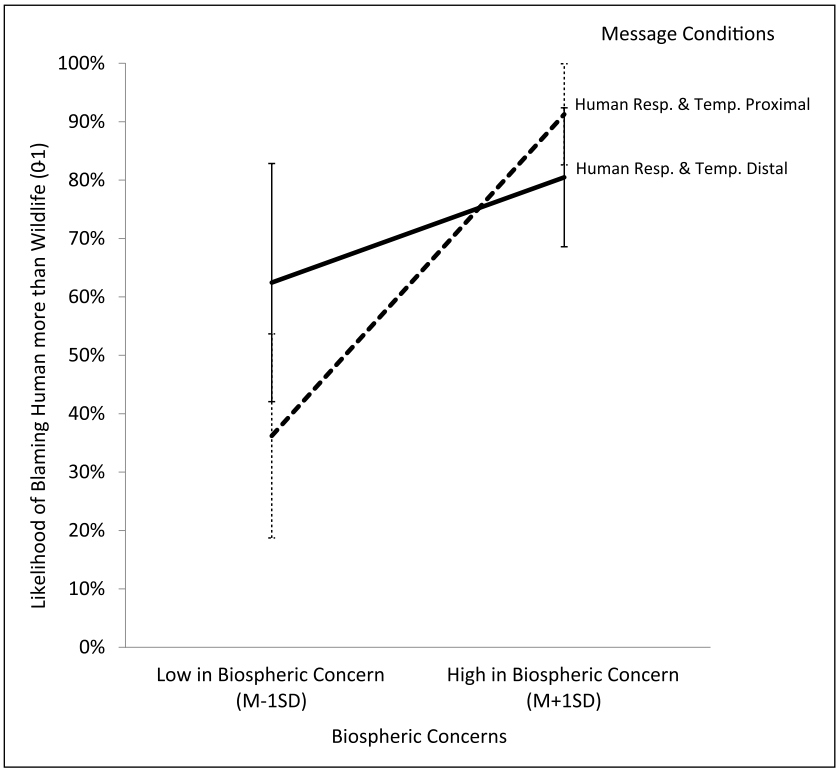

Figure 2. Graph depicting the interaction between message conditions and biospheric concern on blaming humans more than animals.
Error bars represent 95% confidence intervals around the predicted mean of the item.

interaction term was reduced from $|t| = 2.59$, $p = .01$, to $|t| = 1.07$, $p = .28$. Thus, on accounting for the likelihood of blaming humans more than animals and letting the indirect effect be moderated via the proposed mediator, the residual direct effect of the human responsibility with temporally distal (vs temporally proximal) message condition on conservation intentions no longer depended on biospheric concern, thereby establishing the conditions for a mediated moderation.

4. Discussion

This study assessed conditions under which One Health messages may enhance conservation intentions among individuals most likely to reject its tenets of shared human responsibility for environmental risks and thus engage in motivated reasoning: individuals low in biospheric concern. The results suggest that messages that emphasize the temporally proximal nature of the risk and human responsibility for the risk do not enhance conservation intentions among those low in biospheric concern more than messages emphasizing animal responsibility and either temporally proximal or distal frames. Yet, messages that juxtapose human responsibility with a temporally distal frame increased conservation intentions among those low in biospheric concern. Further findings show that this message effect is mediated by an increase in the acceptance of the message's core arguments regarding human responsibility for the wildlife disease risk.

A growing body of literature documents that attributing human responsibility does not necessarily lead to greater public acceptance for the human role in creating environmental risks (Nisbet et al., 2015; Roh et al., 2015). Research has shown that people who tend to disagree with such an account may process messages defensively, resulting in an opposite-than-intended or boomerang effect (Kahan, 2013). Since One Health messages reach diverse audiences varying in environmental beliefs, finding ways to counteract possible unintended consequences—such as fear of wildlife or lack of support for conservation actions—is critical.

This research suggests one initial step toward designing effective messages that incorporate One Health tenets, namely, interdependency and shared responsibility. Importantly, our findings appear contrary to the assumption of many environmental and medical practitioners subscribing to the One Health approach by suggesting that portraying risks as imminent may lead to defensive processing among audiences for whom more distally framed risks may, in fact, spur intended outcomes. Arguably, this result may cause some concern given the scientific reality that many conservation challenges and wildlife disease risks are, indeed, happening today. Our results, however, are both actionable and have some degree of ecological validity. When environmental or public health agencies issue public messages about wildlife disease risks, our results suggest that the seemingly innocuous wording of "today" or "in the future" has the potential to improve or undermine message effectiveness.

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Notes

1. GfK's panel recruitment rate at the time of our study was 14.9% (response rate 3; AAPOR Standard Definitions, 2011) and a profile rate of 65.4%. These yield a cumulative response rate of 4.9%.
2. While these items may not directly capture ways to prevent chronic wasting disease (CWD), these measures do indicate a support for preservation of parks or natural areas. Such behaviors can be critical to preserving biodiversity, which has indirect significance in wildlife disease prevention and other One Health efforts.
3. Items measuring biospheric concern have varied between studies (De Groot and Steg, 2008; Schultz, 2001; Van Der Werff et al., 2013), but they generally suggest the similar predictive validity for pro-environmental behaviors. We employed the current measurement scale as it identifies levels of concern about (attitudes toward) specific species (i.e. bird, plant, animal, and marine life), which appear to be more relevant to the One Health tenets, whereas the other measurement items ask about relatively abstract value-related phrases or statements (e.g. respecting the earth).
4. The index was formulated as follows, which runs from −1 (absolute animal blame) to 1 (absolute human blame)

$$Relative\,human\,blame\,index = \frac{Human\,Blame\,Score - Animal\,Blame\,Score}{Human\,Blame\,Score + Animal\,Blame\,Score}$$

5. All results controlled for whether or not participants have ever heard about CWD before taking the survey, but the pattern of results did not change when this control was included. An analysis of variance on biospheric attitudes across the experimental conditions indicated that the message manipulation did not affect participants' biospheric attitudes, $F < 1$.

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