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Abstract
Risk scholars have long examined how public opinion about environmental issues is shaped by message framing devices, for example, as when climate change is portrayed as a ‘public health’ vs. ‘environmental health’ issue, or when the phenomenon itself is labeled as ‘global warming’ vs. ‘climate change.’ Yet, seldom do these framing devices occur in isolation; instead, they often co-occur – or intersect – in messaging about emerging environmental risks, which may hold underappreciated implications for theory and practice. This paper introduces the concept of intersecting frames, which we define as occurring whenever communicators emphasize a subset of the available aspects of an issue (i.e. emphasis framing) that itself is referred to using one of a larger set of alternative labels used to represent the issue in discourse. As an initial exploration of the concept, we report on a web experiment featuring 602 US respondents in which Vibrio bacteria in oysters was framed primarily as a risk either to public or environmental health that was attributed either to ‘global warming’ or ‘climate change.’ Whereas prior research suggested that public health framing and climate change labeling should reduce climate skepticism, we observed increased skepticism among political conservatives when these framing devices were employed simultaneously. We discuss possible cognitive mechanisms that may underlie effects of intersecting frames and consider implications for risk communication more broadly.

In recent years, research examining the message features that bolster the public’s risk perceptions related to climate change has expanded rapidly (e.g. Mossler et al. 2017; O’Neill and Nicholson-Cole 2009; Pidgeon and Fischhoff 2011; van der Linden, Maibach, and Leiserowitz 2015), and scholars have highlighted a clear role for risk researchers in communicating the complexity of the issue in ways that are both effective and scientifically sound (e.g. Lorenzoni, Pidgeon, and O’Connor 2005). Risk communication scholars have drawn on the rich literature on framing effects to guide these efforts (e.g. Alexander 2010; Goffman 1974; Lakoff 2010; Nisbet 2009; Tversky and Kahneman 1981), leading to dozens of empirical examples of the ways that often-subtle differences in the portrayal of climate change and its associated threats can influence public perceptions of the issue (e.g. Feldman and Hart 2015; Myers et al. 2012; Schuld, Konrath, and Schwarz 2011; Spence and Pidgeon 2010). While some research suggests that particular message frames may not appreciably affect audience responses to climate change (e.g. Bernauer and McGrath 2016), the bulk of available evidence suggests that a variety of ways of framing climate change can exert detectable effects on many outcomes of interest to risk communicators, including climate change existence beliefs (e.g. Schuld, Enns, and Cavaliere 2017).
perceived threat of climate impacts (Spence and Pidgeon 2010), and behavioral intentions (Gifford and Comeau 2011; Morton et al. 2011; Scannell and Gifford 2013), among others.

Although framing has been a productive theoretical lens for generating research questions and hypotheses regarding messaging effects on climate-related risk perceptions, it is not without its challenges. In general terms, framing refers to the process by which particular concepts or ways of understanding are made salient by a message (often, a communicative text), thereby encouraging audiences to interpret the issue at hand using these accessible concepts as opposed to other relevant concepts that could have been made salient but were not (Druckman 2004; Entman 1993). Framing can thus be understood through more general models of information processing from social and cognitive psychology, which emphasize the role of contextual cues (e.g. words) in activating previously stored knowledge and mental schema (i.e. frames in thought) that, once activated, can exert marked influence over judgment and decision processes (e.g. Bargh 1989; Fiske and Taylor 1991; Higgins 1989; Scheufele 2000; Scheufele and Tewksbury 2007; Srull and Wyer 1979; Strack, Martin, and Schwarz 1988). Even so, perhaps in part because of its perceived utility and application across many social science disciplines, framing has been described as a ‘fractured paradigm’ (Entman 1993) – a ubiquitous idea that suffers from theoretical clarity, making it difficult to discern precisely what is meant by ‘frame’ and ‘framing’ across different fields, or even across studies within a given field (see Cacciatore, Scheufele, and Iyengar 2016; Krippendorff 2017; for recent critiques). In addition, by presenting audiences with a single frame in isolation, the typical framing study has been criticized for oversimplifying ‘real-world’ communication settings in which audiences are often confronted with multiple alternative frames that compete for influence (Chong and Druckman 2007; Druckman 2010).

Drawing together these complementary perspectives, the current paper introduces the concept of intersecting frames in the communication of risk and uncertainty surrounding environmental issues, such as those related to climate change. Just as real-world communication settings often feature more than one salient frame that can interact in shaping how audiences process information (Chong and Druckman 2007), we suggest that messages often feature intersecting frames – that is, more than one framing device that may similarly interact in their effects and thus hold underappreciated implications both for the framing literature and communication practitioners tasked with communicating uncertain environmental risks to the public.

After briefly overviewing extant approaches to framing in the risk literature, we introduce the concept of intersecting frames in more detail. Then, as an initial exploration of the utility of this concept, we analyze data from a recent experiment that examined message effects in the context of increased rates of *Vibrio* bacteria in oysters, which can be passed to humans who consume raw or undercooked oysters. This context is useful because the rising risk of bacterial infection can be framed as either an ‘environmental health’ (because of its risk to oyster populations) or a ‘human health’ (because of its risk to oyster consumers) issue, which, in turn, can be attributed to anthropogenic stressors associated with either ‘global warming’ or ‘climate change.’ We consider whether and why these framing devices (i.e. emphasis frames and labels) may interact in influencing issue-related beliefs, as well as the role of prior beliefs and values orientations (e.g. political ideology) in these effects.

**Framing risk**

For decades, risk scholars have recognized and sought to advance understanding of the role of framing in risk perception. This includes examining how different ways of portraying substantively equivalent risk information can affect audience responses, as well as how different presentation formats can affect risk perception itself. In their seminal work on prospect theory, Tversky and Kahneman, (1981) found that framing the same outcome of a hypothetical disease outbreak in terms of loss (i.e. the proportion of people who would die) vs. gain (i.e. the proportion of people who would survive) led participants to exhibit more risk-seeking preferences, choosing the option that involved a gamble (i.e. a \( \frac{1}{3} \) chance that no one would die and a \( \frac{2}{3} \) chance that 600 people would die) over a normatively equivalent certain loss (i.e. the death of 400 people). According to Druckman (2001), framing effects in which
audience preferences are shaped by different presentations of mathematically equivalent information are examples of *equivalency framing* (other examples include ‘90% fat-free’ vs. ‘10% fat’), as distinguished from *emphasis framing*, which occurs when the same issue (say, a Ku Klux Klan rally) is described using different sets of readily applicable concepts that invite distinct connotations and interpretations (e.g. a KKK rally as a ‘public safety’ issue or a ‘free-speech’ issue; Chong and Druckman 2007).

On the risk perception side, research finds that different ways of framing the same issue in terms of broad societal concepts (e.g. as an ‘economic’ as opposed to a ‘scientific’ issue) can shape how audiences judge its associated risks (Vaughan and Seifert 1992). Haider-Markel and Joslyn (2001) found, for instance, that framing gun policy in the US in terms of safety as opposed to individual rights affected support for concealed handgun legislation. More recently, prominent scholars have called for increased attention to the ways that often-subtle differences in the language employed in climate change messaging can affect audience perceptions (Lakoff 2010), with some evidence suggesting that a ‘public health’ framing of the issue (vs. a more traditional ‘environmental’ frame) can invite increased engagement from more skeptical and dismissive audiences (Maibach et al. 2010; Myers et al. 2012). From a cognitive-psychological perspective, these effects are theorized to operate through basic principles of cognition, such that frames in communication (e.g. often, variants in wording) increase the accessibility or salience of previously stored knowledge structures in the minds of an audience (*priming* in psychological terms), thereby increasing the likelihood that that knowledge – as opposed to other relevant considerations – will be brought to bear on subsequent judgments (e.g. Chong and Druckman 2007; Higgins and Brendl 1995; Wyer and Srull 1986). In the case of public health framing effects among more skeptical audiences, such (re)framing techniques presumably operate by activating considerations that are better aligned with the core values orientations of key audience segments (e.g. for conservatives and Republicans, considerations of human systems vs. environmental regulation) (Nisbet 2009).

**Intersecting frames and environmental risks**

Emphasis frames, like those mentioned above, are ubiquitous in public discourse about emerging environmental risk issues. Beyond the present context of climate change, the method of hydraulic fracturing used for shale gas extraction has been framed by proponents in terms of bringing much-needed economic opportunities and energy security to the US and other nations, and by opponents in terms of an environmental pollution – and even an environmental justice – issue (Fry, Briggle, and Kincaid 2015). Similarly, the public controversy over biotechnology has been framed both in terms of its threats and benefits to public health as well as to the environment (e.g. Freedman 2013; Lomberg 2013), and scholarly interest in the framing of risks from other science and technology issues abounds (e.g. nanotechnology; Allan, Anderson, and Petersen 2010). Importantly, in communicating about the risk and uncertainty surrounding these issues, emphasis frames are not the only kind of framing device employed; emphasis frames are frequently accompanied by one or more labels for the issue itself, which research suggests carry their own connotations that are capable of shifting public perceptions. Research has shown, for instance, different reactions to the terms ‘fracking’ vs. ‘shale oil or gas development’ (Clarke et al. 2015), ‘agricultural biotechnology’ vs. ‘GM’ (Zahry and Besley, forthcoming), and ‘global warming’ vs. ‘climate change’ (Akerlof and Maibach 2011; Schuldert et al. 2011, 2017; Villar and Krosnick 2011; Whitmarsh 2009). Among other findings, research on the latter suggests that compared to climate change, global warming is a more politicized label, inviting greater skepticism from individuals who may be predisposed to challenge the existence of global climate change (e.g. Republicans and conservatives in the United States). Although researchers have grounded these effects in the literature on framing, and emphasis framing in particular, there may be significant and underappreciated value in distinguishing labels from frames given their different features and, possibly, different mechanisms by which they exert influence (for a discussion, see Schuldert 2016).

Especially germane to the present work, despite the growing awareness of and interest in the need to move beyond examination of the effects of single frames presented to audiences in isolation (Chong and Druckman 2007), research has yet to examine potential *interaction* effects between emphasis frames.
for a given issue and the labels used to represent it in messaging. There are compelling reasons for doing so. Beyond their frequent co-occurrence in media and everyday communication (e.g. as in the headline ‘Climate change is a human rights issue,’ De Schutter 2012; emphasis added), research suggests that both emphasis frames and issue labels are independently capable of eliciting different audience responses to important environmental risk issues. In classic work on the episodic vs. thematic framing in news coverage (Iyengar 1990, 1996), news portrayals of social problems (poverty) that focus on the plight of the affected individual rather than more general societal institutions and structures invite attributions of responsibility to the individual vs. society. Suggesting such effects are indeed mediated by differential thought accessibility, Valkenburg, Semetko, and De Vreese (1999) find that news framing activates frame-consistent thoughts and shapes audience recall. Naturally, exposure to different labels can influence the cognitive accessibility of related content stored in memory (Collins and Loftus 1975) consistent with basic principles of cognitive priming (Bargh 1989). For example, in the climate change context, Whitmarsh (2009) found that among survey respondents in the south of England, the label ‘global warming’ brought to mind stronger heat-related concepts (e.g. melting ice) and associations of human rather than natural causes, relative to ‘climate change.’ In related work in the US context, Schuldt and Roh (2014) reported that such accessibility differences may be moderated by political disposition – conservatives were less likely to associate heat-related connotations (rising temperatures and melting polar ice) with ‘climate change’ than with ‘global warming,’ whereas liberals did not show this difference. Little is known, however, about whether the influence of a given emphasis frame may vary as a function of the label used to represent the issue in messaging.

Research in the judgment and decision-making tradition may offer useful insights. As a long literature attests, judgments are not simply an automatic product of information rendered accessible by situational cues; rather, decision-makers often engage meta-cognitive inferential processes that govern how the information is ultimately used in judgment (e.g. Higgins, Rholes, and Jones 1977; Schwarz and Clore 1983; Schwarz et al. 2003). In particular, the applicability of primed information to the judgment context at hand is a core consideration in predicting the nature of accessibility effects, with robust experimental evidence that accessible content exerts stronger effects when it is deemed highly diagnostic, or relevant, to the immediate judgment (Higgins 1996). Similarly, studies exploring the influence of emphasis framing on audience reactions to environmental risk messaging may expect stronger messaging effects when the emphasis frame and the label employed prime congruent cognitive content; in contrast, when frames and labels activate incongruent (or less congruent) content, we predict weaker effects (see Figure 1 for a conceptual model). For example, emphasis framing that positions hydraulic fracturing as an economic issue may exert a greater influence under the ‘shale gas development’ as compared to the ‘fracking’ label, given the former’s likely more positive connotations related to economic progress. In contrast, a message that frames the same issue in terms of its environmental

Figure 1. Conceptual model of intersecting framing effects. Note that the label- and frame-related knowledge and concepts that are primed or activated by the framing devices in communication are expected to be influenced by a variety of background and individual difference factors not appearing here (domain familiarity, relevant values and ideologies, etc.), as well as the perceived applicability of primed content to the outcome judgment at hand.
impacts may resonate more strongly when accompanied by the ‘fracking’ label, given that label’s more negative connotations (Evensen et al. 2014).

Intersecting frames in communicating climate-related risk and uncertainty

More than any other environmental risk issue, communication scholars have explored the role of framing in the context of climate change, and we chose to analyze experimental data from this context as an initial exploration of the utility of the intersecting frames concept. In doing so, we draw together the two lines of work on framing devices in climate change discourse mentioned above: (a) emphasis framing (e.g. of an issue as a ‘public health’ vs. an ‘environmental’ threat) and (b) labeling effects (e.g. of ‘global warming’ vs. ‘climate change’) to explore the possibility of contingent effects on audience responses in the context of an emerging environmental risk.

As previously mentioned, we examine this possibility in the context of the increasing presence of the Vibrio bacteria in oysters. In November 2012, a panel of scientists convened by Washington State Governor Christine Gregorie issued a set of recommendations to address growing concerns over rising ocean temperatures and acidity levels linked to anthropogenic carbon emissions. The changes threaten the viability of oyster larvae, the panel explained, and create ideal conditions for the spread of certain risks – such as the transmission of Vibrio bacteria from oysters to humans. The increasing presence of Vibrio poses risks not only to the state’s nearly $300 million annual oyster industry but also health of the oyster-consuming public, causing a painful infection that can lead to death (Department of Ecology 2012).

On the basis of the framing research reviewed above, it would appear that environmental risk messaging that emphasizes negative consequences for public health that are linked to climate change should promote greater message acceptance and reduced skepticism. Emerging marine risks that scientists link to global anthropogenic stressors, as with Vibrio in oysters, provide an ideal case for exploring this possibility, given that communicators may choose to place more emphasis on either their consequences for environmental health (e.g. oyster populations) or public health (e.g. oyster consumers), while simultaneously emphasizing global warming or climate change as the chief cause (e.g. as in this headline: ‘Why oyster lovers should worry about climate change,’ Danson 2013). Thus, this context provides fertile ground for exploring what happens when these two different types of framing devices intersect within the same message – a topic that has received little attention from climate communication scholars or in the framing literature more broadly.

The present study

In light of such headlines about Vibrio in oysters and other issues that jointly touch upon climatic changes, environmental/ecosystem health, and human health (i.e. ‘one health’ issues; e.g. Decker et al. 2012), the present study sought to investigate the possible interactive effects of these two types of climate frames. Specifically, it explored the following research questions:

RQ1: How might these two types of framing devices that commonly intersect in news reports about environmental risk issues (namely, public health vs. environmental health framing and global warming vs. climate change labeling) interact to affect the public’s responses to environmental risks?

RQ2: How might this pattern vary by political orientation, which is frequently found to moderate framing effects in environmental risk messaging?

Method

Participants

We recruited a sample of US-based participants ($n = 602$) from Amazon’s Mechanical Turk (MTurk) (www.mturk.com) – a crowdsourcing website that has become a common recruitment tool across the social
sciences in recent years (e.g. see Berinsky, Huber, and Lenz 2012; Mason and Suri 2012) – to participate in a 5–10-min ‘opinion study’ in exchange for a nominal fee. This web-based study follows similar work by McComas et al. (2015) that examined effects of message framing on support for marine policy among an independent sample of participants (i.e. 543 ferry passengers in Washington State) (see Footnote 1). The present web survey was open to all US-based users of MTurk, and the sample was majority male ($n = 340$, or 56.5%), the mean age was 34 years old (SD = 12 years), and a strong majority ($n = 528$, or 87.7%) reported at least some college education (nearly half, $n = 290$, reported holding a bachelor’s degree or higher). Politically, the sample leaned liberal ($M = 3.16$, SD = 1.64; scale from 1 = very liberal to 7 = very conservative), with 60% reporting a liberal ideology (1–3 on the scale) and 22% reporting a conservative ideology (5–7) (18% chose the scale midpoint).

**Experimental stimuli**
Upon arriving to the study’s website, participants first consented and were then instructed to read a short news article and answer questions about it. The article described the work of scientists studying the linkages between carbon emissions, marine ecosystem changes (including ocean warming and acidification), and disease-causing pathogens afflicting oyster populations in the US Pacific Northwest (i.e. *Vibrio* bacteria). Depending on the condition, the article emphasized either the consequences for oyster health, or in addition the consequences for human health (via consumption of raw or undercooked oysters). Also varied was whether *Vibrio* outbreaks were said to be due to ‘global warming’ or ‘climate change’ (see Appendix for complete text). In addition, for comparison purposes, a control group was not exposed to any news article and simply completed the measures.

**Measures**
Before answering the demographic questions reported above, all participants completed a series of measures that are common in polling on environmental issues and allowed us to explore the influence of intersecting frames on public perceptions (RQ1) – specifically, support for environmental policies to reduce greenhouse gas emissions and emerging marine disease; attributions of responsibility for changing ocean temperatures and acidity; and certainty that global climate change is really happening. Each measure is detailed below.

**Policy support**
Participants first completed three items that assessed support for federal policies aimed at reducing climate change (i.e. *The United States should reduce greenhouse gas emissions; The United States should regulate carbon dioxide as a pollutant; The United States should encourage industry to shift away from using fossil fuels*) {1 = strongly support to 6 = strongly oppose}, which we averaged to form a single-measure index of support for climate change policy ($\alpha = .87$). Participants then completed three items that assessed support for federal policies aimed at reducing the outbreak of marine diseases (i.e. *The United States should protect coastal industries from harmful bacteria or disease in the ocean, The United States should limit public health risks from harmful bacteria or disease in the ocean, The United States should reduce threats to marine life from harmful bacteria or disease in the ocean*) {1 = strongly support to 6 = strongly oppose}, which we again averaged to create a single-measure index of support for marine disease policy ($\alpha = .90$).

**Causal attributions**
Participants next completed two items that assessed attributions of responsibility for changing ocean conditions that promote marine disease either to human or to natural causes (i.e. *Do you think a change in the ocean’s acidity is being caused …, Do you think a change in the ocean’s acidity is being caused …*) {1 = Entirely by things people do to 5 = Entirely by natural causes). These items were averaged to create a single-measure index of causal attribution to humans vs. nature ($\alpha = .86$).
Belief in global climate change

Participants then answered the following question assessing their belief that global climate change is really happening, which was worded with whichever label (‘global warming’ or ‘climate change’) that participants were exposed to in their randomly assigned news article condition: *You may have heard about the idea that the world’s temperature may have been going up over the past 100 years, a phenomenon sometimes called global warming [climate change]. What is your personal opinion regarding whether or not this has been happening?* {1 = Definitely has not been happening to 7 = Definitely has been happening}.

Results

To address our research questions regarding whether the public’s response to environmental risk information varies as a function of how emphasis framing and issue labeling intersect in messaging (RQ1), and further whether these effects are contingent on political orientation (RQ2), we conducted a series of ANOVA and regression models that examined treatment effects on the aforementioned outcome measures. The first set of analyses simply examined whether the means of each outcome measure varied across experimental condition, and the second set focused on moderation analyses to explore whether the influence of experimental condition was dependent on political ideology. The policy support measures were reverse coded such that higher values corresponded to greater support. We also reverse coded the attribution measure, such that higher values corresponded to greater attribution of human responsibility for changing ocean conditions.

Taking policy support first, we observed no overall effect of experimental treatment on support for climate change policy or support for marine disease policy, $F < .63, ns$. Mean-level support for climate change policy ranged from $M = 3.77$ (SD = .97) in the control condition to $M = 3.92$ (SD = 1.05) in the Oyster Health × Climate Change condition, whereas support for marine disease policy was notably higher, ranging from $M = 4.71$ (SD = .93) in the control condition to $M = 4.88$ (SD = .75) in the Oyster Health × Global Warming condition. As expected, when we added political ideology to the models, that variable emerged as a strong significant predictor ($F > 50, ps < .001$), such that conservative ideology significantly predicted lower levels of support for both climate change policy (Pearson’s $r = –.49$) and marine disease policy ($r = –.27; ps < .001$). Although political ideology itself was a significant predictor of policy support, we observed no significant interaction effects between political ideology and experimental treatment, $F < 1, ns$.

Causal attributions were similarly unaffected by experimental treatment, $F (4, 595) = 1.13, ns$. On average, participants tended to see humans as more responsible for changing ocean temperature and acidity than natural causes, with means ranging from $M = 3.47$ (SD = .88) in the Public Health × Climate Change condition to $M = 3.69$ (SD = .75) in the Oyster Health × Climate Change condition. Once again, when added to the model, political ideology emerged as a strong significant predictor ($F > 120, p < .001$), such that conservatives were less likely to attribute causality for changing ocean conditions to human activity ($r = –.42, p < .001$). Although political ideology itself was a significant predictor of causal attributions, we observed no significant interaction effects between political ideology and experimental treatment, $F < 1, ns$.

Turning to belief in global climate change, we examined mean-level of belief across six conditions, as half of the participants in the control reported their belief in ‘global warming,’ whereas half reported their belief in ‘climate change.’ We observed no overall effect of experimental treatment on existence beliefs, $F (5, 595) = 1.10, ns$. Mean-level existence beliefs were generally high, ranging from $M = 5.50$ (SD = 1.68) in the Climate Change × Public Health condition to $M = 5.95$ (SD = 1.31) among control condition participants who saw no news article and simply reported their belief in ‘climate change.’ When political ideology was added to the model, it again emerged as a strong significant predictor of existence beliefs ($F > 130, p < .001$), with conservatives reporting less certainty that global warming or climate change is really happening ($r = –.43, p < .001$). Notably, we also observed a significant interaction effect between political ideology and experimental treatment on existence beliefs, $F (5, 588) = 2.62, p = .02$ (Figure 2).
We diagnosed this interaction using regression procedures (for simple slope and spotlight analysis) outlined by Aiken and West (1991). Results revealed that emphasis framing (Oyster Health vs. Public Health) moderated the interaction between global warming/climate change labeling and political ideology on existence beliefs that has been previously reported in national-level survey experiments (Schuldt et al. 2011, 2017). Specifically, whereas conservative participants ($M + 2SD$) reported less belief in ‘global warming’ than ‘climate change’ in both the control ($M_{GW} = 4.21$ vs. $M_{CC} = 5.28$; $t(588) = 1.99$, $p < .05$) and Oyster Health conditions ($M_{GW} = 4.14$ vs. $M_{CC} = 5.02$; $t(588) = 1.93$, $p = .05$), this pattern was not observed in the Public Health condition. To the contrary, conservatives reported marginally lower levels of belief in ‘climate change’ than ‘global warming’ when the news article emphasized consequences for Public Health ($M_{GW} = 4.64$ vs. $M_{CC} = 4.04$; $t(588) = −1.64$, $p = .10$), the lowest mean-level beliefs observed among conservatives across all conditions.3

**Discussion and conclusion**

Are effects of emphasis framing in communication about environmental risk and uncertainty contingent on the label used to represent the issue? Whereas previous work suggested that reframing climate effects in terms of their public health consequences may reduce skepticism and increase climate engagement among audience members who are typically more dismissive of the problem, research has yet to consider how this reframing might interact with ‘global warming’ vs. ‘climate change’ labeling to shape audience beliefs in the context of emerging climate-related news. In addition to raising this theoretical possibility, the present work offers some initial evidence that emphasis framing and issue labeling may interact to shape a key outcome of exposure to environmental risk messaging: the public’s level of certainty that global climate change is really happening. We examined these intersecting frames in the context of *Vibrio* bacteria in oysters, which scientists have linked to climatic changes and which has clear effects for both environmental health (i.e. the oyster populations themselves) and public health (i.e. the millions of people who eat raw or undercooked oysters). Although we did not observe effects of message framing on policy support or causal attributions for changing ocean conditions, we did observe an interactive effect of message framing and political ideology on the belief that global climate change is really happening. This finding may be notable, given that past research has found that conservatives typically express greater belief in the existence of ‘climate change’ than ‘global warming’; here, we replicate this pattern in the control condition, and find that it is eliminated when participants read a mock news article that framed outbreaks of *Vibrio* disease in terms of their consequences for public health. In fact, in the condition that combined public health framing and climate change labeling, conservatives reported the lowest levels of existence belief that we observed across all conditions.

If the public health framing and climate change label promote reduced skepticism among conservatives when employed separately, what might explain why they appear to increase skepticism when
employed simultaneously? A possible explanation may lie with the different connotations carried by global warming and climate change that were alluded to earlier. For example, to the extent that ‘climate change’ conjures stronger connotations of consequences for the natural (non-human) world than does ‘global warming,’ audience members who are predisposed to challenge or resist climate change messaging might be especially resistant when reading about public health consequences of climate change. In other words, relative to the ‘global warming’ label, the ‘climate change’ label may prime associations that are less congruent with the notion of risks to humans as opposed to non-human organisms and natural systems, and thereby may promote weaker climate beliefs among the very audience members that messages may be most intended to persuade. Future research should attempt to address this proposed mechanism directly.

We note some of the limitations of this work. Although our decision to recruit experimental participants from Amazon’s Mechanical Turk platform afforded a reasonably diverse participant pool in terms of gender, age, and political ideology, it is unlikely that our participants were very familiar with the topic of the news articles (i.e. Vibrio bacteria in oysters) prior to the study. We might well expect a different pattern of results had we instead sampled from a group with more knowledge of this issue, or of ecology, biology, and/or disease processes more broadly. Indeed, when we examined whether the interaction effect between experimental treatment and political ideology on belief in global climate change found in the present web survey sample emerged among our earlier sample of over 500 ferry riders in Washington State – for whom marine disease topics are likely to be more familiar and salient – this effect was not observed, suggesting that the results reported here may be context-sensitive and thus generalizations to other populations and settings should be made with caution. Rather than making strong claims about the reliability of the effects reported here, our intention is instead to draw attention to the concept of intersecting frames while offering an experimental approach that environmental and risk communication researchers may find useful. In addition, the conceptual model for intersecting frames that we offer is primarily intended to draw scholars’ attention to instances in which framing devices co-occur (in a complementary fashion) rather than compete as alternative means for understanding and interpreting the same issue (Chong and Druckman 2007). Future theoretical and empirical work may fruitfully consider the additional process factors that are undoubtedly at play but that are not mentioned explicitly in Figure 1, such as the role of audience background and individual difference factors that moderate the link between exposure to framing devices and heightened cognitive accessibility (such as knowledge and political orientation; e.g. see Mossler et al. 2017; Schuld and Roh 2014) or metacognitive processes that are known to mediate the relationship between primed content and its influence on outcome judgments (e.g. Schwarz 2004).

In closing, it is our hope that this work calls attention to the need for risk communication scholars to attend not only to message contexts in which two or more available frames bear on human judgment and perceptual processes, but also to cases where framing devices are simultaneously employed within the same message – that is, when frames intersect. Through close consideration of the cognitive content they prime and their relative degree of congruence, scholars may be in a better position to generate hypotheses regarding the manner and extent to which messaging about emerging environmental risks is likely to influence diverse audiences.

Notes

1. The study by McComas et al. 2015 examined politics-contingent effects of ‘public health’ vs. ‘environmental health’ framing of Vibrio disease among a sample of ferry passengers in the US state of Washington. Results showed greater support for policies aimed at improving environmental conditions (e.g. regulating carbon dioxide as a pollutant) in the public health condition, an effect that was significant among Republicans but not Democrats.

2. Studies have shown that more subtle labeling differences (e.g. ‘fracking’ vs. ‘hydraulic fracturing’) may not produce the same effects (Stoutenborough et al. 2016), suggesting that further research is necessary to understand the conditions under which specific labeling effects emerge.

3. Mean-level existence beliefs observed in the remaining conditions were as follows: Public Health × Global Warming (M = 5.77, SD = 1.44), Oyster Health × Climate Change (M = 5.72, SD = 1.38), Oyster Health × Global Warming (M = 5.86, SD = 1.40), and Global Warming (control) (M = 5.64, SD = 1.51).
Disclosure statement

No potential conflict of interest was reported by the authors.

References


Appendix

Below are the full texts of the articles from the oyster health and public health conditions (global warming/climate change treatment in parentheses):

**Public health condition**

**Bacteria on the half shell? Climate change (Global warming) may increase threats to public health**

Seattle, WA – Scientists are studying links between climate change (global warming), oysters, and public health risks in the Pacific Northwest. Carbon emissions are causing increases in water temperatures and the ocean's acidity, and these increases contribute to diseases that affect human and marine life. Carbon dioxide in the atmosphere lowers the pH of oceans, turning waters more acidic. The Northwest is home to some of the most corrosive waters on the planet. Warmer waters lead to more disease-causing pathogens in the ocean that can threaten both public and marine animal health.

Although oysters are just one of many ocean creatures affected by climate change (global warming), the evidence for links between climate change, oysters, and human disease risk is particularly strong. As Kelly Thompson, a staff scientist with the Ocean Disease Institute, explained,

‘Warmer ocean temperatures lead to more disease-causing pathogens in the ocean that are concentrated by oysters. These bacterial and viral pathogens can make people sick when they eat raw or undercooked oysters.’

All of these factors lead to public health risks and pose a significant economic threat to the oyster industry.

**Oyster health condition**

**Bacteria on the half shell? Climate change (Global warming) may increase threats to oyster health**

Seattle, WA – Scientists are studying links between climate change (global warming) and oyster disease risks in the Pacific Northwest. Carbon emissions are causing increases in water temperatures and the ocean's acidity, and these increases contribute to diseases that can affect marine life. Carbon dioxide in the atmosphere lowers the pH of oceans, turning waters more acidic. The Northwest is home to some of the most corrosive waters on the planet. Warmer waters lead to more disease-causing pathogens in the ocean that can threaten marine animal health.

Although oysters are just one of many ocean creatures affected by climate change (global warming), the evidence for links between climate change and oyster disease risk is particularly strong. As Kelly Thompson, a staff scientist with the Ocean Disease Institute, explained,

‘Higher acidity hurts oysters’ ability to form, build, and maintain their shells and can kill the baby shellfish. The combination of increased acidity and warmer water temperatures might also lead to more disease-causing pathogens in the ocean that make oysters sick.’

All of these factors lead to oyster health risks and pose a significant economic threat to the oyster industry.