

RESEARCH ARTICLE



Metaphors for the War (or Race) against Climate Change

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ABSTRACT

Despite overwhelming scientific consensus, millions of Americans fail to view climate change as a pressing threat. How can we address this disconnect between science and public opinion? In the present study, we investigated the role of metaphorical framing in shaping attitudes toward climate change. Participants read a brief article that metaphorically described US efforts to reduce carbon emissions as a *war* or *race* against climate change, or non-metaphorically described it as the *issue* of climate change. We further manipulated whether these emission-reduction goals emphasized the relatively near or distant future. We found that, compared to the *race* frame, the *war* metaphor made people perceive more urgency and risk surrounding climate change and express a greater willingness to increase conservation behavior, irrespective of the time horizon. Those who read the non-metaphorical report tended to respond in between these two extremes. We discuss the implications of these findings for climate communications.

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Introduction

In December 2015, 195 countries signed a landmark agreement at the UN Climate Change Conference in Paris, France, aimed at reducing greenhouse gas emissions worldwide and limiting the effects of global warming. Though some critics have argued that this pact does not go far enough to address the ecological dangers we are facing, most scientists, policymakers, and members of the international media agree that this represents a substantial and necessary step toward tackling anthropogenic climate change. For the first time, nearly every nation on earth is pledging to address what an overwhelming majority of scientists view as an undeniable fact: Climate change is real, and caused in no small part by human activity (Cook et al., 2016).

Despite this momentous transnational achievement, Americans remain more divided than ever on the issue. According to 2014 polling data (Saad, 2014b), 25% of Americans were still highly skeptical of climate change, a more than 100% increase in global warming skeptics from 2001. Meanwhile, the number of “concerned believers” was down to 36% in 2014, from a high of 49% in 2001. In that same time period, the public’s confidence in their own beliefs has increased: The percentage of people claiming to understand the issue of global warming “very well” has risen from 11% in 1992 to 33% in 2014 (Saad, 2014a). This makes it especially alarming that one-third of Americans polled in 2015 claimed that the effects of global warming will never occur or will only affect future generations (Saad, 2015). More recent data suggest that only half of the population believes that

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global warming is mostly human caused and only 20% say they are “very worried” about the issue (Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Rosenthal, 2016).

This disconnect between public opinion and scientific consensus is troubling, and illustrates in part the power that special interest groups and the media have in shaping public opinion. Consider, for example, the disproportionate amount of attention paid to the “Climategate” scandal of 2009, where the hacked emails of climate scientists at the University of East Anglia were released online, purporting to show the willful manipulation of global warming data. Though the scientific community was quick to point out the irrefutable evidence for anthropogenic climate change in the wake of this controversy, coverage of this event may have been responsible for a sharp spike in global warming skepticism the following year (Leiserowitz, Maibach, Roser-Renouf, Smith, & Dawson, 2013; Saad, 2014b).

Behavioral research may help address the widespread apathy toward climate change by illuminating when, how, and why framing techniques influence how people think and reason about environmental issues. For example, some work has shown that conservatives are more likely to express pro-environmental attitudes when the issue is framed in terms of the moral concern of purity (Feinberg & Willer, 2013), and that Independents and Republicans are just as likely to support a carbon tax as Democrats when it is described as an “offset” cost, rather than a “tax” (Hardisty, Johnson, & Weber, 2010). Other research has found that reading about a climate change impact relevant to one’s local area can also increase climate change engagement (Scannell & Gifford, 2013). On the other hand, a recent study concluded that simple framing techniques might not be sufficient to boost public support for certain climate policies (Bernauer & McGrath, 2016).

In the current study, we investigate how people’s attitudes toward climate change can be changed with metaphor. Linguists, psychologists, philosophers, and communications researchers have long argued that metaphor can be a powerful tool for influencing how people think and feel about complex social issues (Lakoff, 2008; Sopory & Dillard, 2002; Thibodeau & Boroditsky, 2011, 2013). Metaphors are ubiquitous in natural language and sub-serve a variety of cognitive, affective, and social functions in communication: They can be used to efficiently represent and communicate about abstract topics, establish common ground between speakers, and allow people to leverage their structured knowledge of a source domain to organize how they understand and reason about the target domain in question (Gibbs, 1994; Lakoff & Johnson, 1980; Thibodeau & Boroditsky, 2013; Thibodeau, Crow, & Flusberg, 2016).

Recent studies have found that metaphors can subtly shape how people think about a variety of important domains. For example, metaphorically describing crime as a *beast* that *preys* on a city leads people to support more enforcement-based solutions to the crime problem (analogous to how people think about addressing a literal beast problem) compared with describing the same issue as a *virus* that *infects* a city (Thibodeau & Boroditsky, 2011, 2013). Similarly, thinking about a *monster* wildfire that *eats up* land and *devours* homes leads to a greater willingness to evacuate than does a *major* wildfire that *burns* land and homes (Matlock, Gann, Bergmann, & Coe, 2015). These findings suggest that metaphors are useful because they activate conceptual schemas (e.g. for dealing with a beast on the loose) that can be used to reason about a target domain (e.g. for dealing with criminals on the loose), and because they can trigger emotional responses that are known to affect reasoning about risks (e.g. feelings of fear or anxiety in response to a monster; see Loewenstein & Lerner, 2003; Slovic, Peters, Finucane, & MacGregor, 2005; Thibodeau et al., in press).

In recent years, climate scientists and communications scholars have noted the need to analyse metaphors that are used to describe how humans interact with the environment (e.g. Larson, 2011; Nerlich, Koteyko, & Brown, 2010; Nisbet, 2009; Princen, 2010; Raymond et al., 2013). For instance, Shaw and Nerlich (2015) point out that public discourse about climate change is often framed in economic, cost-benefit, terms, where the “ecosystem service” metaphor plays an important cognitive function. Grounding discussions of climate policy in terms of monetary value provides a simple mental model for thinking about the environment and evaluating policy interventions. However, this metaphor may be overly restrictive and lead people to assume that

there is a straightforward trade-off between sustainable environmental policies and economic growth.

Research on metaphors in environmental language is useful and informative, but it is also important to examine whether and how they can affect people's attitudes toward climate change as well as their willingness to change their own behavior to mitigate the risks associated with global warming. Though research on this topic is limited, one recent study found that, compared to plain text and pie charts, explicit comparisons to other domains (If 97% of doctors concluded that your child is sick, would you believe them?) were not as effective at communicating the scientific consensus on the reality of climate change (van der Linden, Leiserowitz, Feinberg, & Maibach, 2014). This suggests that metaphorical comparisons may not be all that useful in climate communications. However, because so much uncertainty surrounds the topic of climate change—an enormously complex phenomenon that unfolds in varied and dynamic ways over different regions and timescales—messaging campaigns may choose to target any number of different attitudes, beliefs, or behaviors beyond basic acceptance of the scientific consensus. The current study therefore represents an important step toward understanding the role of metaphor in climate communications. We focus on how metaphor framing might affect the following:

- (1) Goals: Do people believe that government efforts to reduce the national carbon footprint are realistic and achievable?
- (2) Urgency and Risk: To what extent do people feel a sense of urgency and perceive the risks surrounding the issue of climate change?
- (3) Behavior change: Are people willing to modify their own behavior and increase their personal conservation efforts?

To address these questions, we designed an experiment to contrast the effects of three different ways of talking about climate change: (1) a metaphorical *war* against climate change, (2) a metaphorical *race* against climate change, and (3) a non-metaphorical framing about the *issue* of climate change.

Our initial hypotheses focused on the *war* frame, which is extremely common in public discourse in a variety of domains (e.g. the war on terror, the war on crime, the war on drugs, the war on poverty, the war on cancer, the war on Christmas), to the extent that approximately 17% of articles in *Time magazine* between 1981 and 2000 contained a war metaphor (Karlberg & Buell, 2005). The war frame has also received some attention in the experimental literature (albeit for other topics; e.g. cancer—see Hauser & Schwarz, 2015), which offers preliminary evidence for the power of the metaphor to shape attitudes and behavior (see also Elwood, 1995). A recent discourse analysis found that war metaphors are frequently used in the British Guardian Online newspaper to talk about climate change politics as well as communicate the urgent need to act on the issue (Atanasova & Koteyko, 2015a). As researchers made clear in a popular science write-up of this work (Atanasova & Koteyko, 2015b), war metaphors may help unite people on an issue by highlighting the seriousness of a problem and the importance of addressing it.

One possibility, therefore, is that by describing US efforts to reduce greenhouse gas emissions as a *war* that must be *fought*, participants in our study would be led to feel an additional sense of urgency and risk surrounding the issue and would be further motivated to address it by modifying their own conservation behavior. On the other hand, Atanasova and Koteyko (2015b) point out that in the context of climate change, war metaphors might actually backfire and fail to increase feelings of urgency, as research has found fear to be largely ineffective at motivating engagement with social issues such as global warming (O'Neill & Nicholson-Cole, 2009). Our study was designed in part to test the efficacy of the war metaphor in discussing climate change and to help adjudicate between these competing predictions.

Study overview

Three samples of data were collected to address the research questions enumerated above: the first, in January of 2016 ($N = 1000$), the second, in March of 2016 ($N = 800$), and the third, in October of 2016 ($N = 1200$). The methods and results are largely consistent in the three datasets, although there are several notable differences that we discuss. In presenting the methods and findings, we have pooled the data from the three samples to present the clearest pattern of results, focusing on findings that are reliable and robust in all three samples.

In the experiment, participants read a fictional newspaper article about climate change and then responded to a series of follow-up questions. Two features of the article were manipulated: first, the article identified a specific time horizon as a target for achieving a reduction in greenhouse gasses, which was situated in the relatively near (2025) or distant future (2115). This manipulation was included for all three samples.

Second, the article framed the effort to reduce greenhouse gas emissions in one of three ways: two of which were metaphorical, as a *war* or *race against* climate change, and one of which was not metaphorical, as the *issue* of climate change (see Figure 1). In the first and third samples, all three of these conditions were included; in the second sample, only the two metaphoric frames were included in order to more carefully compare the effects of *metaphorically* framing a campaign to reduce climate change. Non-metaphorical stimuli may not represent the ideal control condition in studies designed to test how metaphors affect the way people think, given that they differ from metaphorical stimuli in a variety of ways other than simply lacking a figurative component (e.g. vividness, general arousal, reader engagement; for discussion and empirical assessment of this

In response to the recent Paris Climate Talks, the Associated Press released the following brief statement:

THE WAR AGAINST CLIMATE CHANGE

When will Americans start to combat excessive energy use and kill the problems related to air pollution and the destruction of natural resources? The entire country should be recruited to fight this deadly battle. The United States is joining the campaign to reduce its carbon footprint in the next few decades. The US has approved dozens of projects as part of an effort to reduce greenhouse gas emissions by more than 25% by the year [2025/2115]. The projects will leverage scientific expertise and individual engagement to improve the energy efficiency of cars and buildings, reduce personal energy use, and increase the use of renewable energies such as wind and solar. Experts say that if we do not lower emissions in the next [10/100] years, we will experience an increase in extreme weather conditions, more public health problems like a rise in cancer and other diseases, as well as severe economic challenges. This is a war we can't afford to lose!

THE RACE AGAINST CLIMATE CHANGE

When will Americans go after excessive energy use and surge ahead on problems related to air pollution and the destruction of natural resources? The entire country needs to step up to the line and get in front of this challenging problem. The United States is joining the race to reduce its carbon footprint in the next few decades. The US has approved dozens of projects as part of an effort to reduce greenhouse gas emissions by more than 25% by the year [2025/2115]. The projects will leverage scientific expertise and individual engagement to improve the energy efficiency of cars and buildings, reduce personal energy use, and increase the use of renewable energies such as wind and solar. Experts say that if we do not lower emissions in the next [10/100] years, we will experience an increase in extreme weather conditions, more public health problems like a rise in cancer and other diseases, as well as severe economic challenges. This is a race we can't afford to lose!

THE ISSUE OF CLIMATE CHANGE

When will Americans start to address excessive energy use and resolve the problems related to air pollution and the use of natural resources? The entire country needs to direct their efforts to address this important issue. The United States is joining the effort to reduce its carbon footprint in the next few decades. The US has approved dozens of projects as part of an effort to reduce greenhouse gas emissions by more than 25% by the year [2025/2115]. The projects will leverage scientific expertise and individual engagement to improve the energy efficiency of cars and buildings, reduce personal energy use, and increase the use of renewable energies such as wind and solar. Experts say that if we do not lower emissions in the next [10/100] years, we will experience an increase in extreme weather conditions, more public health problems like a rise in cancer and other diseases, as well as severe economic challenges. This is a situation we can't afford to ignore!

Figure 1. Brief paragraph stimuli used in the experiment. All participants read the preamble at the top, followed by one of the 6 paragraphs below (3 frames \times 2 time horizons).

issue, see Thibodeau & Boroditsky, 2015). However, a condition that frames the issue non-metaphorically may provide a useful point of comparison for the two metaphorical treatment conditions in this case, given the practical applications of the current work (we elaborate on these issues in the General discussion).

After reading the fictional newspaper article, participants answered a series of follow-up questions. All three samples were asked (a) whether they thought the US would be able to achieve the emissions reduction goal, (b) to rate the urgency of the challenge, and (c) about their view of the risk that climate change posed. The second and third samples were also asked (d) a set of questions about their willingness to change their behavior to reduce their own carbon footprint.

Methods

Participants

A total of 3000 participants were recruited and paid through Amazon's Mechanical Turk, an online crowdsourcing platform that is popular with social scientists. Mechanical Turk has been shown to yield high-quality data and is more representative than other commonly used convenience samples (Berinsky, Huber, & Lenz, 2012; Buhrmester, Kwang, & Gosling, 2011; but see Paolacci & Chandler, 2014, for discussion of trade-offs associated with social science research with this population of participants). We restricted our sample to people living in the US who had a good performance rating (>90%) on previous Turk tasks. Not analysed were data from participants who failed to complete the study or from participants who did not seem to read the article (i.e. who advanced past this screen in less than 2 seconds). In addition, a small number of participants in Sample 1 (or 2) submitted data for Sample 2 (or 3); data from these participants were also excluded. Table 1 shows the demographic information for the three samples.

The samples did not differ in age, education, political affiliation, political ideology, racial identity, or belief in global warming. They did, however, show a difference by gender, although, critically, the different conditions within each of the samples were balanced for gender (i.e. had a similar proportion of males and females in each condition), as well as for the other demographic variables. Nevertheless, to control for this difference across the samples, and to account for potential differences in the salience of climate change as a function of when people participated in the study, we controlled for *sample* in our analyses, as discussed below.

Materials and procedure

Stimuli. Participants first read a brief fictional newspaper article that situated US efforts to reduce greenhouse gas emissions metaphorically as “The War Against Climate Change” or as “The Race Against Climate Change,” or non-metaphorically as “The Issue of Climate Change” (see Figure 1). Participants in Samples 1 and 3 were randomly assigned to one of these three frames; Participants in Sample 2 were randomly assigned to one of the two metaphoric frames. The frame was presented as the title of the article and was extended throughout the description. For instance, in the *war*

Table 1. Demographic information of samples.

	Sample 1	Sample 2	Sample 3
N Analysed	979	759	1124
Age	35.9 (11.3)	35.3 (11.4)	34.7 (10.9)
Gender: Male***	47%	52%	37%
Education: Completed some college	87%	88%	88%
Political Affiliation: Democrat, Republican	40%, 20%	40%, 23%	37%, 23%
Political conservativeness	40.8 (27.3)	43.2 (28.7)	43.1 (26.8)
Race: White	83%	83%	81%
Belief in global warming	3.98 (0.88)	3.97 (0.92)	3.94 (0.89)

condition, participants read statements about how the US was seeking to “combat” excessive energy use and “kill” problems related to air pollution. In the *race* condition, participants read statements about how the US was seeking to “go after” excessive energy use and “surge ahead” on problems related to air pollution. In the (non-metaphorical) *issue* frame condition, participants read about how the US was seeking to “address” excessive energy use and “resolve” problems related to air pollution. Aside from metaphorical content, the linguistic forms used in the articles were identical, including the same sentence structure, for instance, “This is a war we can’t afford to lose!” and “This is a race we can’t afford to lose!”

Both metaphorical frames are common in climate change discourse, as seen in recent print media headlines—for instance, in *The New York Times*, “We don’t need a ‘war’ on climate change, we need a revolution” (Godoy & Jaffe, 2016), and in *Forbes* magazine, “In race against climate change, innovations to this ingredient could determine the future of brewing” (Nurin, 2016). Such framing is ubiquitous in discussion of societal issues, including political campaigns (see Matlock, 2012, for a discussion of race metaphors in particular).

In addition to manipulating the frame, the article either situated emission-reduction goals in the relatively near (2025) or distant (2115) future (e.g. The US has approved dozens of projects as part of an effort to reduce greenhouse gas emissions by more than 25% by the year 2025/2115). This manipulation was included for all three samples.

Norming study. To ensure that all six versions of the target article were similarly clear and easy to read, we conducted a norming study. An additional group of 300 participants was recruited from Mechanical Turk, and randomly assigned to read one of the six versions of the fictional news article and to answer five questions about the article’s *difficulty*, *clarity*, *complexity*, *concreteness*, and *vividness*. These questions, taken from prior work on metaphor framing (Burgers, Konijn, Steen, & Iepma, 2015), were asked on a 5-point rating scale that ranged from Strongly Disagree to Strongly Agree. Data were excluded from participants who did not complete the study or who read the article in less than two seconds, which left data from 289 participants for analysis.

A series of ANOVAs revealed that the articles did not differ in their comprehensibility (i.e. ratings of *difficulty*, *clarity*, *complexity*, and *vividness*; all $ps > .09$). There was some evidence that the metaphoric conditions were perceived as less *concrete* than the non-metaphoric condition, as would be expected. However, this effect was only marginally significant and only reliable in the *far* time horizon ($F [2, 283] = 2.90, p = .057$). Although one would expect metaphoric descriptions to be seen as less concrete than non-metaphoric descriptions, the abstract nature of climate change in general, and the use of highly conventional metaphors in these articles may have led people to think of the conditions as using language that was similarly concrete.

Target questions. After reading the article, participants in the experiment were asked to make a judgment about the feasibility of the goal described in the article (“Will the US achieve its goal of reducing greenhouse gas emissions by more than 25% by the year 2025/2115?”; yes or no), and to rate their confidence in this judgment (on a 5-point scale that ranged from 1, “Not at all confident” to 5, “Very confident”). There was relatively little variability in participants’ confidence ratings (most participants, 63%, reported that they were “somewhat confident” in their judgment), and this did not differ significantly by the experimental manipulations. Thus, we do not report further analyses on this measure in the Results section.

Participants also rated the *urgency* of the problem (How urgent is it for the US to implement energy reduction programs right away?) on a 5-point scale that ranged from 1, “Not at all urgent” to 5, “Very urgent,” and reported their perception of the risks posed by climate change (Jones, Clark, & Tripidaki, 2012). The risk perception measure asks participants to consider 13 potential consequences of climate change (e.g. soil erosion, drought, international conflict) and to rate their level of concern for each on a 7-point scale (Cronbach’s $\alpha = .93$).

Participants in Samples 2 and 3 (but not Sample 1) were then asked six questions about their willingness to change specific behaviors in order to mitigate the effects of climate change (on a 5-point scale that ranged from 1, “Definitely No,” to 5, “Definitely Yes”):

- (1) Would you be willing to pay a carbon offset cost on future purchases of items derived from fossil fuels?
- (2) Would you be willing to contribute money toward education initiatives designed to teach people about risks associated with climate change?
- (3) Would you be willing to pay more for health initiatives designed to deal with health-related issues we are now facing due to climate change?
- (4) Would you be willing to decrease your use of air conditioning and heating in order to reduce your carbon footprint?
- (5) Would you be willing to decrease your use of goods and services that contribute to greenhouse gas emissions and pollution?
- (6) Would you be willing to decrease your intake of agricultural products that derive from farming techniques known to contribute to climate change?

We aggregated responses to these six questions into a single measure of *willingness to change behavior* (Cronbach's $\alpha = .86$).

At the end of the survey, participants answered demographics questions about their age, gender, educational history, political party affiliation (categorically, as Democrat, Independent, Republican, or Other), and political ideology (on a continuous scale that ranged from 0, "Very liberal," to 100, "Very conservative"). Of note, recent work has shown that although there tend to be fewer participants who identify as Republicans than as Democrats or Independents on Mechanical Turk, participants on the platform usually behave in ways that are representative of their political identity (i.e. the platform is valid for psychological research on issues that tend to be influenced by political identity; Clifford, Jewell, & Waggoner, 2015).

Participants were also asked two questions about their belief in global warming by indicating their agreement with two statements on a 7-point scale (i.e. "I believe that burning fossil fuels increases atmospheric temperature to some measurable degree" and "I believe that the burning of fossil fuels on the scale observed over the last 50 years has increased atmospheric temperature to an appreciable degree"; Cronbach's $\alpha = .89$; Lewandowsky, Oberauer, & Gignac, 2013). As expected, people who identified as politically conservative were less likely to report a belief in global warming, $r [2860] = -.512, p < .001$ (Bernauer, 2013).

As part of a secondary research project, participants in Sample 1 also completed scales that measured the degree to which people think about the earth as a system (i.e. the Systems Thinking Scale; Thibodeau, Frantz, & Stroink, 2016), free market ideation (Heath & Gifford, 2006), and the tendency to endorse conspiracy theories (Lewandowsky et al., 2013). Because responses to these measures do not bear on our primary research questions, they are not discussed any further.

Analysis

We used logistic regression to analyse participants' judgment of whether they thought the US would be able to achieve its climate reduction goal. We used linear models to analyse ratings of urgency, risk perception, and willingness to change behavior. In all four models, we included categorical predictors for the two experimental manipulations in order to test for a main effect of the frame and time horizon, as well as to test for an interaction between these factors. We also included a categorical predictor for the sample (1, 2, or 3) and a continuous predictor for participants' belief in global warming as covariates. Participants' belief in global warming was included as a covariate in the models to (a) account for the primary source of variance in the data—and, thus, to more clearly detect and quantify the influence of the experimental manipulations—and (b) test whether the effects of the experimental manipulations were modulated by participants' prior beliefs about the anthropocentric origins of climate change.

For the logistic regression, we compared a series of nested models to test the statistical significance of including the predictor variables. The deviance between the models (i.e. difference in likelihood

ratios) is reported as an index of model fit: model deviance approximates a χ^2 distribution with the number of added parameters as its degrees of freedom (Menard, 2002).

For the linear models, we report F -ratios to test for omnibus differences—for example, to test whether there are differences by frame (issue, race, war). Then we report standardized coefficients from the corresponding linear regression model to quantify the size and direction of statistically significant effects (Howell, 2012).

The data for these studies are available on the Open Science Framework: osf.io/45rnj.

Results

The results of analyses on the four outcome measures are presented in Table 2, which are described in detail in the following subsections.

Goal

We first fit a series of logistic regression models to participants' judgments of whether the US would achieve the emissions reduction goal. The models revealed a main effect of the time horizon manipulation, $\chi^2(1) = 71.70, p < .001$, Cramer's $V = .16$ ($\beta = .68, SE = .08$), and participants' belief in global warming, $\chi^2(1) = 37.42, p < .001$, Cramer's $V = .11$ ($\beta = .24, SE = .04$). No other main effects or interactions were statistically significant (see Table 2). As shown in Figure 2, participants were more likely to think the goal would be achieved if the target deadline was 2115 (71%) than 2025 (56%).

Urgency

A linear model was fit to ratings of the urgency of addressing climate change and revealed main effects of the frame, $F[2, 2848] = 3.51, p = .030, \eta^2 = .002$, participants' belief in global warming, $F[2, 2848] = 1843.17, p < .001, \eta^2 = .391$, and the sample, $F[2, 2848] = 3.80, p = .022, \eta^2 = .002$. No other main effects or interactions were statistically reliable (see Table 2).

As shown in Figure 3, people thought the problem was the most urgent in all three samples when the report identified climate change as an enemy in a war. Ratings of urgency in the war condition were significantly different from ratings of urgency in the race condition, $B = .090, SE = .043, p = .038$; ratings of urgency from the issue condition did not differ from the war, $B = -.049, SE = .049, p = .314$, or race conditions, $B = .041, SE = .048, p = .396$.

Participants in Sample 3 tended to view the issue as more urgent than participants in Sample 1, $B = .081, SE = .034, p = .017$, or Sample 2, $B = .807, SE = .039, p = .024$; there was no difference between the ratings of participants in Sample 1 and Sample 2, $B = .006, SE = .034, p = .882$. This may reflect the fact that Sample 3 was collected after the hottest summer on record and during a

Table 2. Results of statistical models that included tests of the experimental manipulations (frame and time horizon), participants' belief in global warming, and sample, on the four outcome measures: the goal judgment and assessments of urgency, risk perception, and willingness to change one's behavior. A χ^2 statistic shown for the analysis of the goal judgment; F -ratios are shown for the analyses of urgency, risk perception, and willingness to change one's behavior; additional details for each of the models are provided in the text. Asterisks indicate statistical significance at the * $p < .05$, ** $p < .01$, and *** $p < .001$ levels.

	Goal	Urgency	Risk perception	Behavior
Frame	2.00	3.51*	5.60**	8.61***
Time horizon	71.70***	0.61	1.41	0.36
Belief in global warming	37.42***	1843.17***	1489.86***	1113.28***
Sample	1.04	3.80*	2.96	1.99
Frame * Time	2.87	1.26	0.50	0.88
Frame * Belief	0.01	0.14	1.80	1.62
Time * Belief	0.41	2.10	3.43	0.99
Frame * Time * Belief	3.36	0.34	0.23	1.81

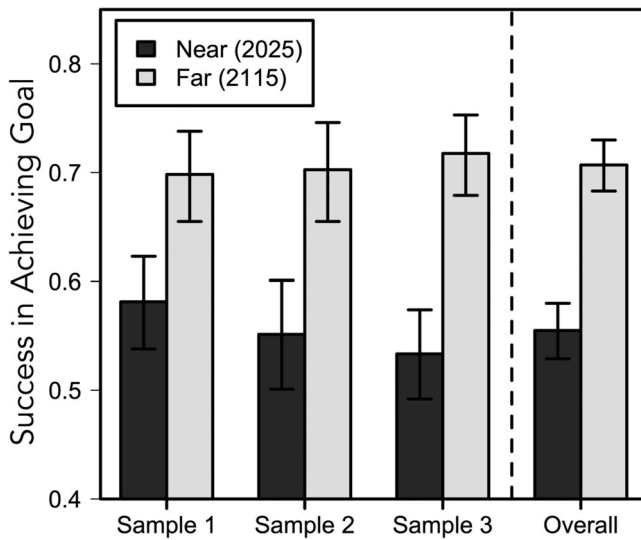


Figure 2. Goal by time horizon for each sample and overall (all samples collapsed). Error bars represent 95% confidence intervals.

heated election cycle in the US, when issues with political implications like climate change are more salient. However, as noted, the effect of the framing manipulation was consistent in the three samples.

Finally, there was a strong positive relationship between participants' belief in global warming and ratings of urgency, $B = .627$, $SE = .015$, $p < .001$.

Risk perception

A similar model tested for effects of the experimental manipulations and covariates on *risk perception*. It revealed a main effect of frame, $F [2, 2848] = 5.60$, $p = .004$, $\eta^2 = .003$, a main effect of

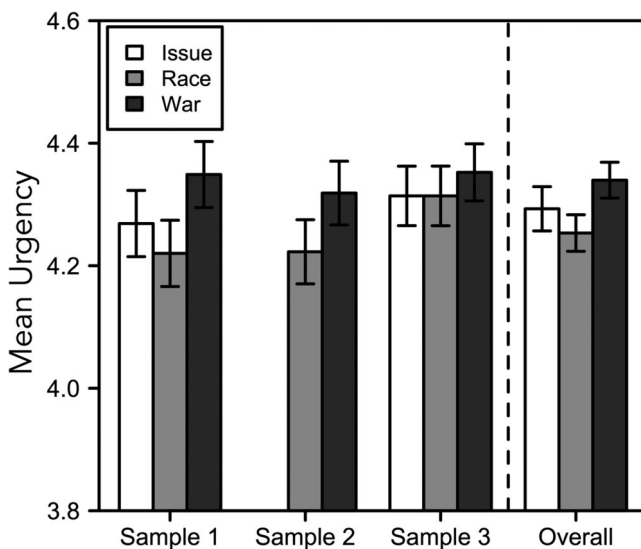


Figure 3. Mean urgency for each framing condition, broken down by sample and for participants overall (all samples collapsed). Error bars represent standard errors of the means.

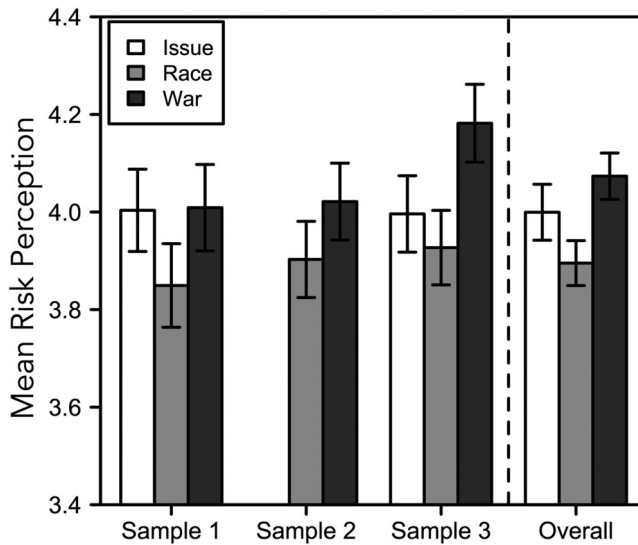


Figure 4. Mean risk perception for each framing condition, broken down by sample and for participants overall (all samples collapsed). Error bars represent standard errors of the means.

participants' belief in global warming, $F [2, 2848] = 1489.86, p < .001, \eta^2 = .341$, and a marginal main effect of sample, $F [2, 2848] = 2.96, p = .052, \eta^2 = .001$. No other main effects or interactions were statistically significant (see Table 2).

As shown in Figure 4, participants reported the most risk when climate change was framed as a war. The war and race frames differed significantly, $B = .084, SE = .035, p = .016$; neither metaphoric frame differed significantly from the issue frame, $ps > .25$.

Ratings of risk perception were higher in Sample 3 than in Sample 1, $B = .082, SE = .035, p = .021$, and marginally higher than those of Sample 2, $B = .066, SE = .040, p = .099$; there was no difference between Samples 1 and 2, $B = .015, SE = .041, p = .707$. Again, this may have to do with the timing of when these samples were collected.

As expected, there was a strong positive relationship between participants' belief in global warming and ratings of urgency, $B = .656, SE = .017, p < .001$.

Willingness to change behavior

A final model tested for effects of the experimental manipulations and covariates on participants' willingness to change their behavior. It revealed a main effect of frame, $F [2, 1870] = 8.61, p < .001, \eta^2 = .006$, and a main effect of participants' belief in global warming, $F [2, 1870] = 1113.28, p < .001, \eta^2 = .369$. No other main effects or interactions were statistically significant (see Table 2).

As shown in Figure 5, participants reported the most willingness to change their behavior when they received the war frame. The war and race frames differed significantly, $B = .108, SE = .037, p = .004$; the war frame was marginally different from the issue frame, $B = .089, SE = .049, p = .069$; the race and issue frames did not differ from one another, $B = .019, SE = .048, p = .696$. And, as expected, there was a strong positive relationship between participants' belief in global warming and ratings of urgency, $B = .605, SE = .018, p < .001$.

General discussion

Many nations worldwide have come to agree with scientists that global warming is real, and that there is an urgent need for people need to get behind the idea that our climate is changing. Yet,

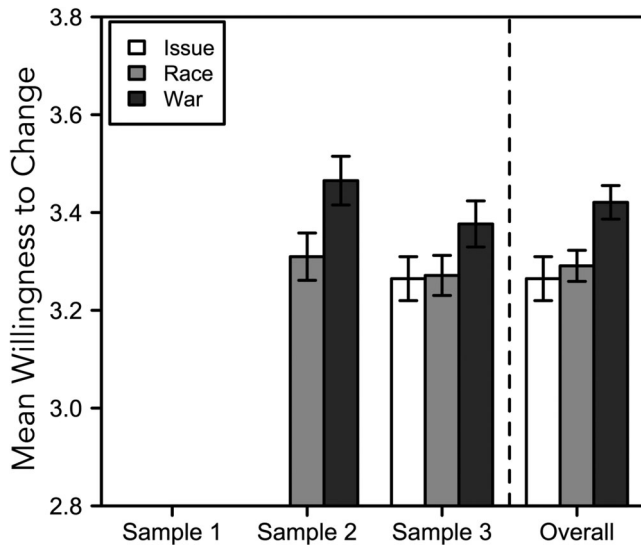


Figure 5. Mean willingness to change behavior for each framing condition, broken down by sample and for participants overall (all samples collapsed). Error bars represent standard errors of the means.

despite hard scientific evidence and broad acknowledgment of the problem, some people remain indifferent, confused, or downright opposed to the idea of anthropogenic climate change.

The current study is an important preliminary investigation of the effects of metaphor framing on attitudes toward climate change and intentions to engage in conservation behaviors. Participants read a brief article that metaphorically framed US efforts to reduce carbon emissions as a *war* or *race* against climate change, or non-metaphorically framed these efforts in terms of the *issue* of climate change. We further manipulated whether these emission-reduction goals emphasized the relatively near or distant future. After reading the article, participants responded to a series of questions probing their attitudes toward climate change, and in some cases, they also indicated their willingness to engage in a variety of conservation behaviors, such as reducing their intake of agricultural products that derive from farming techniques known to contribute to climate change.

We focused primarily on the role of metaphor because metaphor is known to influence reasoning in general, and because climate discourse is riddled with metaphorical language that draws on the race and war source domains, as evident in headlines like: “Are we losing the race against climate change?” (*NPR*), and: “World losing battle against global warming” (*USA Today*). Because of the potential practical applications of this work, however, the inclusion of the non-metaphorical condition provides an important contrast to the metaphorically framed reports.

Across three large samples of US participants—collected at different times during the 2016 calendar year—those who read the *war* metaphor article consistently reported a greater sense of urgency and a greater perception of risk surrounding the issue of climate change, as well as a greater willingness to increase conservation behavior, compared with those who read the *race* report. Though the observed effect sizes were modest, they are consistent with other research on metaphor framing (Sopory & Dillard, 2002; Thibodeau & Boroditsky, 2013; Thibodeau & Boroditsky, 2011), and even small effects can have significant impacts in social and political media campaigns where outcomes are often decided by slim margins (see Prentice & Miller, 1992).

Interestingly, the effects of the war frame were consistent whether US efforts to reduce greenhouse gas emissions were situated in the relatively near or far future. Though federal emission reduction goals did seem more realistic and achievable when these goals were more temporally distant, this time horizon manipulation did not affect feelings of urgency or risk, nor did it affect a willingness to change behavior to mitigate the effects of global warming. This is an important finding, because

it indicates that the effects of metaphor framing we observed do not depend on whether government efforts to tackle the issue seem realistic or not.

Taken together, these results suggest that people are sensitive to the valence and intensity of the *war* frame, and the observed pattern of results supports the hypothesis that war metaphors increase feelings of urgency and risk surrounding the issue of global warming (Atanasova & Koteyko, 2015a). These findings may be valuable to policymakers, politicians, public utility officers, newscasters, and others who seek greater awareness of risk and “buy in” via public messaging. A war frame is useful to framing issues around climate change because it captures attention. It leads people to infer risks, especially risks associated with damages and loss, loss of lives, loss of money, and more (Loewenstein & Lerner, 2003; Slovic et al., 2005). It also conveys opposition and struggle, and the need to form and sustain a united front to avoid destruction. Thus the war metaphor has both cognitive and affective consequences in the context of climate change. A race frame is also effective, but in some cases may not be as robust at creating a sense of urgency and sparking behavioral changes; for now, the consequences of losing a race do not appear to be as bad as those of losing a war.

It remains to be seen, however, whether war metaphors can be an effective long-term messaging strategy for issues around climate change. An urgent, war-like call to action may be especially motivating in the short-term, but real (and metaphorical) wars tend to lose support over time. Consider the recent US wars in Iraq and Afghanistan: Despite overwhelming political and public support for these incursions in the wake of the 11 September 2001 attacks, by the end of first decade of the millennium, many Americans questioned the decision to use military force (Pew Research Center, 2008). Similarly, the “war on drugs” has lost public support in recent years, as recent polling data indicate that two-thirds of Americans think the government should focus on providing treatment for those who use illegal drugs (Pew Research Center, 2014). On the other hand, the “war on climate change” does not involve the literal use of violence and punishment toward human beings, so it may be that the effects of the metaphorical frame operate differently in this domain. Future research is necessary to fully explore how the effects of metaphor framing shift over time.

In a similar vein, the power of the war frame may vary across different aspects of climate change. Messages about the need to *combat* adverse health effects from air pollution, such as increased risk of asthma and other respiratory diseases from increasing air pollutants, or the need to *fight* against economic risks associated with climate change may lead to a greater sense of urgency than messages about the need to combat sea rise and melting ice sheets. The power of the war frame may also vary depending on the geographical location of heightened risk. How does a war framing work when it is used to target specific problems associated with specific regions, like drought in the Southwest US or blizzards in the Northeast US? Once again, more research is needed to gain a better sense of how and when metaphor is more or less robust in its influence on attitude and behavior.

The discussion so far has focused on contrasting the effects of the *war* and *race* frames on participant attitudes, but we also included a non-metaphorical *issue* frame in two of the samples collected in our study. Participants who read the non-metaphorical article tended to report levels of urgency, risk perception, and willingness to change behavior at a level intermediate between those who read the *war* and *race* reports. However, these responses were for the most part not statistically different from responses in the two metaphorical conditions.

On the one hand, it can be difficult to directly compare how people respond to metaphorical and non-metaphorical stimuli in studies of linguistic framing, since these stimuli will differ in a variety of ways besides the presence or absence of a figurative component (see Thibodeau & Boroditsky, 2015). On the other hand, because of the potential applications of the present research for climate communications and public messaging, it is important to consider the practical significance of participant responses to the *issue* frame. In particular, these findings suggest that talking about climate change using non-metaphorical language may be just (or nearly) as effective as invoking the metaphor of war for promoting a sense of urgency and risk and for encouraging behavior change. This is somewhat consistent with previous work discussed in the introduction, which found that comparisons to other domains (i.e. to doctors’ consensus about a child’s illness) did not facilitate

communication about the scientific consensus on climate change relative to plain text or charts (van der Linden et al., 2014). That being said, the present findings do support the idea that when it comes to choosing a metaphor to talk about climate change, the war metaphor is consistently more impactful than the race metaphor.

As a result, this study may potentially be useful to educators and scientists whose job is to use effective ways to communicate climate findings to a general audience. A growing body of research shows that metaphor plays a vital role in the understanding and communication of abstract concepts in STEM areas, including mathematics (Marghetis & Núñez, 2013; Winter, Marghetis, & Matlock, 2015), biology (Keller, 2002), chemistry (Watkins, 1989), and physics (Pulaczewska, 1999). In addition, more research has begun to investigate metaphors that appear in environmental discourse (e.g. Lakoff, 2010; Larson, 2011; Nerlich et al., 2010). However, little research has focused on the utility of metaphor in discourse about climate change, especially how it may help develop better strategies for communicating about climate change. An important part of the present project involves understanding the inferences people make about urgency and risk related to climate change, and the influence metaphor has on attitudes toward these issues. This work may help us find better ways of talking and thinking about climate change and other large-scale problems in the years to come.

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