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Understanding six "key truths" about climate change predicts policy support, discussion, and political advocacy

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Abstract
Effective communication is critical in efforts to limit and manage the risks of climate change. One empirical approach to crafting effective communication is to start with communication objectives, that is, the attitudes and actions one seeks to influence, then identify the beliefs that are most strongly associated with those objectives, and end by developing and delivering messages to promote those beliefs. This planning process can be iterative over time as the relevant key beliefs evolve. Here, we use data from a US nationally-representative survey conducted in 2023 (n = 1,011) to assess the degree to which six key truths often used by communicators to predict important attitudes (support for government action on climate change) and behaviors (seeking and sharing information about climate change, and engaging in political advocacy to support climate action): (1) climate change is happening ('*It's real'*); (2) human activity is causing climate change ('*It's us'*); (3) there is a scientific consensus about human-caused climate change ('*Experts agree'*); (4) climate change harms people ('*It's bad'*); (5) a majority of people are concerned about climate change and support climate action ('*Others care'*); and (6) actions can be taken to limit the harm ('*There's hope'*). We found that all six key truths are highly predictive of at least one, and in some instances many, of the attitudinal and behavioral outcomes analyzed. These findings suggest that communicating the six key truths about climate change has the potential to help build public and political will for climate solutions.

Keywords Climate change · Communication · Message design

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1 Introduction

The most recent Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) underscores the critical importance of significant and coordinated action aimed at reducing climate change (IPCC, 2023). Rapid and deep reductions in carbon emissions, leading to net zero carbon emissions by 2050 (IPCC, 2023) are essential to realize the 2015 Paris Agreement goal of limiting global warming to no more than 1.5ºC above pre-industrial levels (IPCC, 2018; Rogelj et al. 2018). Concurrently, communities, states, and nations must adopt resilience measures to protect against the rapidly increasing impacts of climate change (IPCC, 2022).

Communication that deepens public engagement in the issue can be a powerful tool in efforts to achieve climate mitigation and resilience policy goals (Maibach et al. 2023). Building public will is key – especially in democratic nations – if people, voters, universities, nongovernment organizations, faith groups, professional societies and others are needed to pressure governments to adopt these policies (Ockwell et al. 2009). Some scholars have referred to this as building a 'public mandate' for climate action that signals to elite institutions the broad, prevailing public will and desire that governments act in-line with their demands (Howarth et al. 2020). Communication arguably has one of the most important roles to play in helping cultivate this public will (Cox 2010; Han and Barnett-Loro 2018; Leiserowitz et al. 2021; Roser-Renouf and Maibach 2018).

The inherent complexity of climate science can be a barrier to effective communication with the general public. Past studies indicate that common climate-related terms, such as "mitigation" and "carbon neutral," are often misunderstood or misinterpreted (Bruine de Bruin et al. 2021). One way to overcome this barrier is through a strategic communication approach focused on developing and delivering simple, clear messages, that are repeated often, by a variety of trusted voices (Maibach et al. 2023; Roser-Renouf and Maibach 2018). This approach is applicable to multiple communication objectives, including building greater support for policies, helping foster behavior changes, among others.

An empirical method for identifying messages with the greatest potential to achieve specific communication objectives, which emerged in the health communication field, involves working backwards from the outcomes of interest. Hornik and Woolf (1999) proposed one such approach using survey data that are representative of the target population. Their analytic method identified fact-based beliefs that meet three key criteria: (1) the beliefs are strongly predictive of the outcomes of interest; (2) a meaningful proportion of the population do not currently hold the beliefs; and (3) the beliefs are amenable to influence through effective communication. Fact-based beliefs that meet these three criteria are considered good candidates for development into messages that can be evaluated for use in subsequent communication initiatives. Beliefs that satisfy all three criteria have the most potential to advance the objectives of interest and are therefore the highest priority for further evaluation through message testing research. The health communication literature indicates this approach has been applied successfully in promoting positive health behavior changes such as encouraging physical activity and boosting vaccination uptake (Cowie and Hamilton 2014; Fishbein and Yzer 2003; Hamilton and White 2011; MacDonald et al. 2013; Zhao 2020). The basic logic inherent in this approach to campaign planning has also been

embraced by some leading experts in climate change (Dietz et al. 2013) and sustainability more broadly (McKenzie-Mohr 2011).

This study applies the Hornik and Woolf (1999) approach to climate communication and contributes to the critically important first step: understanding whether relationships exist between commonly used communication content (i.e., the independent variables of the six key truths) and the intended outcomes (dependent variables). Additionally, in line with the Hornik and Woolf (1999) approach, we determine the relative percentages people that hold the 'correct' or 'incorrect' beliefs pertaining to the key truths. For example, we assess what percentage of people believe the scientific consensus of anthropogenic climate change is greater than 90% ('correct' belief) compared with those who believe it is less than 90% ('incorrect' belief). This is a critical piece of information that applies to the following steps of the Hornik and Woolf (1999) approach when determining whether there is a meaningful proportion of the population that do not currently hold the beliefs. If there is a meaningful proportion not currently holding the 'correct' belief, then that condition suggests there could be a role for strategic communication.

The following section outlines the rationale for our investigation including explication of the dependent variables and predictors (i.e., the "six key truths"). We then describe how each construct was operationalized and then used to build five models designed to investigate which of the key truths – if any – are predictive of our outcomes of interest. Our study is somewhat non-traditional in that we aim to integrate evidence for a set of variables often studied independently, therefore contributing to replication efforts as well as providing an empirical foundation for an existing climate change strategic communication approach that has been useful to practitioners (NASEM, 2019). We allow practice to inform our study, draw on relevant theory and empirical research to inform our methodology, and frame those results in terms of how they can improve strategic communication practice.

1.1 Building public and political will for climate action

Building enduring public will for climate policies requires meeting at least three core objectives, increasing policy support, information seeking and sharing, and political advocacy. These three objectives also form three categories of dependent variables for our study (details can be found in the methods section). Below, we briefly list the high-level structure that groups each of the dependent variables:

(1) Strong public support for the climate policies – dependent variables: mitigation policies such as clean energy funding, carbon pricing and others (a full list used of this study can be found in the supplementary materials).
(2) Seeking and sharing information about climate change – dependent variables: the frequency one searches out information about solutions to climate change, and discussing climate change with friends and family.
(3) Political advocacy in support of climate policy – includes both past behaviors and willingness to do the behavior in the future, which included dependent variables: contacting elected officials (past) and willingness to participate in collective action (future).

Political theorists view signaling the will of the people to political elites as a critical antecedent to establishing enduring policy solutions in democratic countries (Kyselá et al. 2019;

Rhodes et al. 2017). Drews and van den Bergh (2016, p. 856) assert that climate policy support is a "non-activist behavior in the public sphere" and is an important asset for getting policies enacted (Rhodes et al. 2014), and conversely, public opposition can prevent the enactment of climate policy. Moreover, strong public support can protect already enacted policies that might be at risk as a result of changes in government leadership (Goldberg et al. 2020).

Seeking information about climate change is a behavior that is influenced by multiple factors including cognitive, affective, and motivational dimensions like personal needs or desires for information (Choo 2023; Griffin et al. 1999). Previous research has indicated that climate change information seeking and processing are positively related to climate policy support (Yang et al. 2014). Moreover, past studies have found a positive association between how often people share information about climate change – through their discussions with friends, family, and co-workers – and their understanding of scientific consensus about human-caused climate change (Goldberg et al. 2019). Further, discussing climate change can increase both knowledge about the issue and efficacy beliefs which in turn makes participation in future discussions more likely (Fine 2024; Geiger et al. 2017; Goldberg et al. 2019). Hence, information seeking, and information sharing are distinct but related behaviors that are important for cultivating public support for climate solutions.

Lastly, advocacy, such as current political advocacy behavior and willingness to engage in political advocacy, is the third outcome of interest for this research. Surveys of U.S. voters have consistently found relatively low rates of political advocacy behavior such as signing a petition (14%), volunteering time to an organization working on global warming (2%), or engaging in nonviolent civil disobedience (1%) (Leiserowitz et al. 2023a, b, c). However, registered voters become much more willing to engage in political action if someone they like and respect asks them to do so (Leiserowitz et al. 2023a, b, c). While public opinion is an important way of understanding public attitudes and support for climate solutions, political advocacy can be a valuable complement signaling to political elites that there is a strong desire for solutions (Rasmussen et al. 2018).

1.2 Working backwards from objectives to develop messages

As noted above, one approach to strategic communication planning is to start with objectives and work backwards to identify modifiable beliefs that influence them. Roser-Renouf et al. (2014) used this approach to identify predictors of political climate activism among people living in the United States. They found that belief certainty (in the reality of climate change), understanding that climate change is human-caused, perceived risk, collective efficacy, and injunctive beliefs were important predictors. Similarly, Goldberg et al. (2021) found that global warming belief certainty, understanding it is human caused, perceived risk, and perceived social norms all positively predicted climate policy support among U.S. registered voters. Understanding the extent of the expert consensus about human-caused climate change has also been identified as a strong predictor of climate policy support in a range of studies, leading some to refer to it as a gateway belief that influences both attitudes (e.g., support for climate action) and actions (e.g., discussions of global warming) (Goldberg et al. 2019; van der Linden 2021; van der Linden et al. 2019). We describe each of our variables below and discuss them in the context of previous work, therefore, providing

context for the relationships between the six key truths as well as the dependent variables we examine. Given that our study is largely exploratory, we do not provide hypotheses but instead guide our exploration by our research question stated below.

1.3 Six "key truths" about climate change

The climate beliefs identified above – the predictors of our three behavioral outcomes of interest (policy support, information sharing, and policy advocacy) – can be summarized as six simple propositions about climate change: (1) '*it's real*'; (2) '*it's us*'; (3) '*experts agree*'; (4) '*it's bad*'; (5) '*others care*'; and (6) '*there's hope*'. We call these propositions six "key truths" about climate change because they are true and accurate statements. They are fundamentally informed by social science research and theory, and we describe our conceptualizations for each key truth below.

1.3.1 Key truth #1: 'It's real'

Public understanding that the climate is changing is relatively widespread in the U.S. and many other nations (Leiserowitz et al. 2022). 72% of the U.S. adult population thinks that climate change is happening (Leiserowitz et al. 2023b). Moreover, belief certainty about climate change – how confident a person is in their belief that climate change is happening – has risen sharply in the U.S. in recent years. Belief that climate change is happening, specifically how certain one is, predicts both political advocacy in defense of the climate (Roser-Renouf et al. 2014) and climate policy support (Goldberg et al. 2021). Taken together, one's belief about and certainty in the reality of climate change can be understood as a key foundational belief.

1.3.2 Key truth #2: 'It's us'

The IPCC's Sixth Assessment Report (AR6) states that human activity has "unequivocally caused global warming" (IPCC, 2023 p. 4). The second key truth ascribes an anthropogenic (i.e., human) cause to climate change. The essence of '*it's us*' conveys the fact that current global warming has been caused by human activities, primarily by burning fossil fuels which emit heat-trapping gases (IPCC, 2023). A total of 58% of Americans understand this fact, while 29% believe global warming is mostly caused by natural changes (Leiserowitz et al. 2023a). Prior research has shown that belief in the anthropogenic cause of climate change predicts greater policy support (Ding et al. 2011; Drews and van den Bergh 2016). Experimental evidence suggests that higher belief in human causation can lead to greater support for domestic and global climate policies (Jang 2013). Other experimental evidence suggests that messages focused on the human causation of climate change (when paired with information about climate impacts and solutions) can be effective in building policy support among Republicans in the U.S. (Bergquist et al. 2022).

1.3.3 Key truth #3: 'Experts agree'

Estimates of expert consensus (the degree to which climate experts agree human-caused climate change is happening) vary but reach similar conclusions. For instance, a 2016 syn-

thesis of consensus estimates from scientific literature (as well as a survey) concluded that between 90% and 100% of climate scientists are convinced that human-caused climate change is happening (Cook et al. 2016), and a more recent study suggests that as many as 98% of climate scientists agree human-caused climate change is happening (Myers et al. 2021). People's perceptions of the extent of the scientific consensus predict climate policy support (as mediated by other key beliefs including belief certainty, human causation, and efficacy beliefs; Ding et al. 2011). Moreover, messages about the expert consensus can increase perceptions of scientific agreement (van Stekelenburg et al. 2022). Consensus messages are effective across the political spectrum, and do not cause backfire effects among U.S. conservatives (Rode et al. 2022). Perceptions of the scientific consensus can be increased by discussions about climate change, and also predict engagement in future discussions about climate change (Goldberg et al. 2019).

1.3.4 Key truth #4: 'It's bad'

Climate change presents various risks to people, communities, nations, and the world such as extreme weather, sea level rise, and migration of diseases, among others (IPCC, 2023; Romanello et al. 2022). Climate change risk perception is the extent to which one views the likelihood and severity of climate-related adverse outcomes to themselves and the world at large (O'Connor et al. 1999). Scholars have argued that for most people, risk perceptions are influenced not just by logical judgement or cognitive assessment, but also by affective dimensions like worry (Goldberg et al. 2021; Leiserowitz 2005; Slovic 2020; van der Linden 2017). Studies such as Goldberg et al. (2021) identified risk perceptions and worry as important predictors of climate policy support, particularly among U.S. Republicans.

1.3.5 Key truth #5: 'Others care'

Understanding the social norm that '*others care*' – that is, most people are concerned about climate change – is an important social element. In strategic communication practice, the term 'others' is generally used to encompass society at large. Moreover, our conceptualization of 'others care' is meant to be inclusive of many different perceptions of the social environment like second-order beliefs (what one thinks others believe) as well as perceptions of norms. Social norms can be thought of as the "codes of conduct" of a group (Cialdini and Jacobson 2021, p.1). There are at least two distinct types of social norms (1) descriptive norms which characterize what members of a group think, feel, or do, and (2) injunctive norms which characterize what members of a group think is acceptable to think, feel, or do (Cialdini 2012). Social norms can have powerful influences on behavior, (Cialdini and Jacobson 2021; Drews and van den Bergh 2016; Goldberg et al. 2020; Sparkman et al. 2021; van der Linden et al. 2015). For example, surveys find that large numbers of Americans greatly underestimate the descriptive norm that there is widespread public support for climate policy (Sparkman et al. 2021). Correcting misperceptions of social norms such as this has the potential to promote climate change discussions, which are sometimes inhibited by the misperception that one holds a minority opinion on climate change (Geiger and Swim 2016). Research also suggests that perceptions of what others believe is related to support for climate policy (Ballew et al. 2020; Mildenberger and Tingley 2017). Other studies have highlighted

positive relationships between social norms and climate advocacy intentions (Campbell et al. 2023) and past behaviors (Doherty and Webler 2016). However, descriptive and injunctive norms can differ in their influence on attitudes and behaviors, hence, we include both as distinct predictors in this study.

1.3.6 Key truth #6: 'There's hope'

The final key truth pertains to hope, indicating there is still time to act on climate change, a view shared by climate scientists (Stern 2022). Lazarus (1999) defines hope as a belief that "something positive, which does not presently apply to one's life, could still materialize, and so we yearn for it". Ojala (2023) argues that hope can be conceptualized as an emotion or cognitive concept where the cognitive dimension overlaps with other concepts like efficacy. Research suggests that hope is a positive predictor of support for climate policies (Geiger et al. 2023; Myers et al. 2023; Smith and Leiserowitz 2014). Regardless of the conceptual complexity, Geiger et al. (2023) argue the varying conceptualizations of hope have an underlying commonality in that that they all focus on a future-oriented state (Kantenbacher et al. 2022). While there is a rich literature on hope as a discrete emotion (e.g., Ojala 2012, 2023; van Zomeren et al. 2019) we conceptualize it here as a future-oriented focus which includes collective efficacy beliefs about whether people working together can influence what governments and corporations do to combat climate change (Bandura 1977; Hornsey et al. 2022; Luszczynska and Schwarzer 2009) and beliefs that there is still time to left to address climate change. We use a two-part conceptualization of collective efficacy that incorporates both beliefs about the capacity of collective action (i.e., how confident are you that working together you can…) and the outcome expectancy of that action (i.e., … affect what government/corporations does/do about climate change). Efficacy definitions in the literature can sometimes vary (Meijers et al. 2023; Skurka et al. 2023) and hence, we have opted for this conceptualization as it is particularly relevant to climate communication practitioners because it can be applied to mitigation, adaptation, and climate resilience efforts. Collective efficacy is a key belief in fostering both personal engagement with climate change and climate-relevant behavior change (Doherty and Webler 2016; Roser-Renouf et al. 2014; Thaker et al. 2016). The second component – perceived future opportunity – taps into the hope-related notion that there is still time to do something about climate change, the opposite of a fatalistic point of view which can negatively predict policy support, efficacy, and behavioral intentions (Marlon et al. 2019).

1.4 Research question

There are two primary aims of the current research: (1) to assess the extent to which understanding the six key truths predict the outcomes of interest, and (2) to produce practical insights for climate communicators seeking to build public and political will for climate change policies.

Formally stated, we propose this research question:

To what extent does understanding six climate truths ('it's real'; 'it's us'; 'experts agree'; 'it's bad'; 'others care'; and 'there's hope') predict people's climate policy support, information seeking and sharing, and political advocacy?

2 Methods

2.1 Participants

Participants were recruited as part of the Climate Change in the American Mind project. This study includes data from a single survey which was fielded in April-May 2023. It comprises a nationally representative probability sample of the American adult population with a sample size of $n = 1{,}011$. Potential participants are contacted using both address-based and random dialing methods that cover essentially all United States residential addresses. Participants without internet access were loaned devices and given access to the internet to facilitate their participation. A demographic breakdown of the sample in this study can be found in Table 1.

2.2 Study measures

2.2.1 Outcome variables

Policy support A 4-point Likert scale (1 = *strongly oppose* to 4 = *strongly support*) was used to assess climate policy support. In total, 14 policy statements were presented, and partici-

Table 1 Demographic description of sample

Variable		*n*	%
Age	18–24	56	5.5
	25–34	142	14.0
	35–44	148	14.6
	45–54	159	15.7
	55–64	224	22.2
	65–74	182	18.0
	75+	100	9.9
Education	No high school or GED	59	5.8
	High school graduate (high school diploma or GED equivalent)	268	26.5
	Some college or Associate's degree	266	26.3
	Bachelor's degree	223	22.1
	Master's degree or higher	195	19.3
Gender	Female	516	51.0
	Male	495	49.0
Income	Less than $10,000	28	2.8
	$10,000-$24,999	69	6.8
	$25,000-$49,999	147	14.5
	$50,000-$74,999	180	17.8
	$75,000-$99,999	143	14.1
	$100,000-$149,999	186	18.4
	$150,000 or more	258	25.5
Race/Ethnicity	White, Non-Hispanic	710	70.2
	Black, Non-Hispanic	86	8.5
	Other, Non-Hispanic	42	4.2
	Hispanic	133	13.2
	2 + Races, Non-Hispanic	40	4.0

pants were asked to indicate to what extent they supported or opposed the policy. Examples include regulating carbon dioxide (the primary greenhouse gas) as a pollutant, provide tax rebates for people who purchase energy-efficient vehicles or solar panels, and develop a national program to train people from low-income communities and communities of color for new jobs in the renewable energy industry (such as wind and solar). The supplementary materials contain a list of all policy items presented to participants. All items were averaged to form a single 4-point policy support index (M = 2.92, SD = 0.80, α= 0.96).

Behaviors Four behaviors – information seeking, information sharing, political advocacy past behaviors, and political advocacy willingness – were assessed as described below. Because the distributions of the behavioral measures were highly skewed, the variables were dichotomized for analysis.

Information seeking Participants were asked 'About how often do you look for information about solutions to global warming?'. A 5-point scale was originally used to measure responses, but due to skewness of the responses, we dichotomized this variable into: 0 = once a year or less/never (68.0%), and 1 = several times a year or more (32.0%).

Information sharing Participants were asked 'How often do you discuss global warming with your family and friends?'. A 4-point scale was originally used to measure responses, but due to skewness of the responses this was variable was dichotomized into: 0 = rarely or never (63.5%), and 1 = occasionally or often (36.5%).

Political advocacy (past behaviors) Participants were asked the frequency with which they had engaged in climate-related political advocacy in the past 12 months, specifically writing letters, emailing, or phoning government officials about global warming. Response options were 'never', 'once', 'a few times (2–3)', 'several times (4–5)', 'many times (6+)' and 'don't know'. Participants who had done so at least once were asked whether they had urged officials to take action, to *not* take action, or something else. Responses to these questions were combined to create a dichotomous variable: 0 = did not contact government officials or did contact but urged them *not* to act on global warming (91.7%), and 1 = contacted government officials at least once to urge them to take action (8.3%).

Political advocacy (willingness) Participants were asked three questions to assess their willingness to engage in climate-related political advocacy. The question stem 'How likely would you be to do each of the following things if a person you like and respected asked you to?' was followed by: *write letters*, *email*, *or phone government officials about global warming*; *sign a petition about global warming*, *either online or in person*; and *donate money to an organization working on global warming*. Response options were: 1 = definitely would not; 2 = probably would not; 3 = don't know; 4 = probably would and 5 = definitely would. Responses were first combined to form a single index (α= 0.87) on a 5-point scale and then dichotomized such that average index scores of 3.0 and lower (i.e., would not or don't know) were scored 0 (56.8%), and those above 3.0 (i.e., would) were assigned 1 (43.2%).

2.2.2 Predictor variables

Belief global warming is happening ('it's real') Participants were first asked 'Do you think global warming is happening?'; response options were: yes, no, and don't know. Participants answering yes or no were asked a follow-up question: 'How sure are you that global warming [is/is not] happening?'; response options were: not at all sure, somewhat sure, very sure, and extremely sure. These two questions were combined to create a 9-point scale ranging from: 1 = extremely sure is not happening, 5 = don't know, to 9 = extremely sure is happening (M = 6.84, SD = 2.37).

Belief in human causation ('it's us') A single question was used to assess the degree to which participants believed global warming is caused by humans. Participants were asked: 'Assuming global warming is happening, do you think it is…' and there were four options: caused mostly by humans, caused mostly by natural changes in the environment, none of the above because global warming isn't happening, and other. We then dichotomized these into: 0 = global warming isn't happening or is mostly natural (incorrect response) (33.6%), and 1 = caused mostly by human activities (correct response) (58.6%) with other responses treated as missing. We dichotomized this measure to treat it as a binary climate change knowledge question which has correct and incorrect responses.

Perception of scientific consensus ('experts agree') A slider bar was used to assess perceptions of the extent of scientific agreement that human-caused global warming is happening on a continuous scale. The question asked: 'To the best of your knowledge, what percentage of climate scientists think that human-caused global warming is happening?' Responses ranged from 0 to 100% (M = 71.4, SD = 24.9).

Risk perceptions ('it's bad') Participants were asked: 'How much do you think global warming will harm each of the following?'. The stem was followed by: *you personally*, *your family*, *your community*, *people in the United States*, *people in developing countries*, *future generations of people*, *plant and animal species*, *and the world's poor*. Responses options for each statement ranged from 1 = not at all to 4 = a great deal and all statements were averaged to form a single index (M = 2.89, SD = 1.00, α = 0.98).

Two constructs were used to assess the key truth that *others care: descriptive and injunctive norms*.

Descriptive norms ('others care') Participants were asked: 'How much of an effort do your family and friends make to reduce global warming?' measured on a 5-point scale: 1 = no effort, 2 = a little effort, 3 = a moderate amount of effort, 4 = a lot of effort, and 5 = a great deal of effort (M = 2.29, SD = 1.01).

Injunctive norms ('others care') Participants were asked: 'How important is it to your family and friends that *you* take action to reduce global warming?' measured on a 5-point scale: 1 = not at all important, 2 = not too important, 3 = moderately important, 4 = very important, and 5 = extremely important (M = 2.35, SD = 1.15).

Two constructs were used to assess the key truth that there's hope: *collective efficacy* and *perceived future opportunity.*

Collective efficacy ('there's hope') Participants were asked: 'how confident are you that people like you, working together, can…' and were presented with '…affect what the federal government does about global warming' and '…affect what corporations do about global warming'. The two questions were averaged to form a single index representing hope in the form of collective efficacy (Spearman-Brown coefficient = 0.91) on a 5-point scale: 1 = not at all confident, 2 = only a little confident, 3 = moderately confident, 4 = very confident, and 5 = extremely confident (M = 2.40, SD = 1.06).

Perceived future opportunity ('there's hope') We presented participants with a statement on fatalism: 'It's already too late to do anything about global warming' with a 4-point response scale: 1 = strongly agree, 2 = somewhat agree, 3 = somewhat disagree, and 4 = strongly disagree. Due to the wording of the question and response options, responses higher on the scale indicated less fatalism, which we interpreted as greater perceived opportunity that we use as one indicator of hope (M = 3.92, SD = 1.12).

2.2.3 Control variables

Political ideology Political ideology was measured using a single question: "In general, do you think of yourself as…" measured on a 7-point scale: 1 = extremely liberal, 2 = liberal, 3 = slightly liberal, 4 = moderate, middle of the road, 5 = slightly conservative, 6 = conservative, and 7 = extremely conservative (M = 4.11, SD = 1.60).

Political party affiliation Political party identification was measured using the question: "Generally speaking, do you think of yourself as a…" with options being 1 = Republican, 2 = Democrat, 3 = Independent, 4 = Other (please specify), and 5 = No party/not interested in politics. Those who chose options 3 or 4 were provided with a follow-up question that asked "Do you think of yourself closer to the…" with options being 1 = Republican party, 2 = Democratic party, and 3 = Neither. Those who selected one of the parties were then categorized as 'lean' Democrat/Republican. Participants who selected Independent or other to the first question and either refused or selected neither for the second question, were categorized as Independents. Participants who stated they had no party/were not interested in politics were categorized as missing. The two questions were combined to form a single 5-point scale that consisted of 1 = Republican, 2 = lean Republican, 3 = Independent, 4 = lean Democrat, and 5 = Democrat (M = 3.12, SD = 1.66).

A number of demographic variables were also included in the models. Age (measured in years) was included as a continuous variable (M = 52.6, SD = 17.3), race/ethnicity as a dichotomous variable (0 = white (70.2%), 1 = non-white (29.8%)), and gender as a binary variable (0 = female, 1 = male). Education was measured on a 5-point scale from 1 = no high school or GED to 5 = master's degree or higher (M = 3.22, SD = 1.20). Annual household income was measured on a 7-point scale from 1 = less than $10,000 to 7=$150,000 or more (M = 4.91, SD = 1.74). See Table 1 below for additional details.

2.3 Analysis

We constructed two types of regression models (using maximum likelihood estimation) using the statistical software Mplus (version 7). The first was a multiple ordinal least squares (OLS) regression for the policy support dependent variable. The other models (information seeking, information sharing, political advocacy willingness, and political advocacy behaviors) were constructed using multiple logistic regression. Given that the study sample was selected to be nationally representative using a Census-based probability-proportional-to-size procedure, we chose not to include survey weights in our analyses as per the recommendations of Miratrix et al. (2018). As collinearity is unable to be assessed in Mplus, we conducted regressions in SPSS and found VIF and tolerances were within acceptable limits (< 4.0). We include a predictor correlation matrix in the supplementary materials.

3 Results

3.1 Policy support

Most of the six key truths – except for '*it's real*' and one of the two '*others care*' variables (descriptive norms) – significantly predicted climate policy support. The following variables were positively associated with policy support: recognition of the human cause ($\beta = 0.083$, $p = .012$), perceived scientific agreement ($\beta = 0.156$, $p < .001$), risk perceptions ($\beta = 0.359$, $p < .001$), injunctive norms ($\beta = 0.091$, $p = .009$), hope ($\beta = 0.048$, $p = .039$), and collective efficacy ($\beta = 0.060$, $p = .027$). Some demographic variables were also associated with policy support such that those who were younger ($\beta = -0.057$, $p = .015$), female ($\beta = -0.070$, $p = .002$), and had less income ($\beta = -0.081$, $p = .001$) had higher support. Policy support was higher among liberals than conservatives ($\beta = -0.140$, $p < .001$), although political party was nonsignificant.

3.2 Information seeking and sharing

For information seeking, of the six key truths, only descriptive norms were a significant predictor (O/$R = 2.097$, $p < .001$), indicating that descriptive norms were positively associated with information seeking. No demographic or political variables were significant. For information sharing, only descriptive and injunctive norms – representing '*others care*' – were significant predictors; those with greater descriptive (O/$R = 1.587$, $p = .001$) and injunctive (O/$R = 1.385$, $p = .017$) norm perceptions were more likely to share global warming information. The demographic variables of age (O/$R = 1.015$, $p < .05$) and education (O/$R = 1.228$, $p < .05$) were both significant positively associated with information sharing, along with political ideology, which was negatively associated, indicating greater likelihood of sharing among more politically liberal people (O/$R = .755$, $p < .01$) (Table 2).

3.3 Political advocacy behavior (past) and willingness to advocate

The past political advocacy actions model indicated that only the '*others care*' descriptive norm (O/$R = 1.965$, $p = .001$) and '*there's hope*' efficacy (O/$R = 1.403$, $p = .048$) variables

Table 2 Summary of all linear models testing the associations of the six key truths with the dependent variables

Variable	Policy support	Information seeking	Information sharing	Past political advocacy behaviors	Political advocacy willingness
It's real	0.054 *(0.014)*	1.211 *(0.116)*	1.065 *(0.096)*	1.057 *(0.198)*	1.153*(0.116)*
It's us	**0.083***(0.057)*	1.285 *(0.394)*	1.259 *(0.335)*	2.570 *(0.726)*	**3.921*****(0.378)*
Experts agree	**0.156*****(0.001)*	1.009 *(0.009)*	1.006 *(0.007)*	1.014 *(0.012)*	0.999*(0.009)*
It's bad	**0.359*****(0.035)*	1.043 *(0.258)*	1.136 *(0.224)*	1.262 *(0.409)*	1.134*(0.270)*
Others care (desc.)	0.031 *(0.025)*	**2.097***** *(0.164)*	**1.587**** *(0.147)*	**1.965**** *(0.205)*	**1.422***(0.165)*
Others care (injunc.)	**0.091****(0.024)*	1.215 *(0.150)*	**1.385*** *(0.137)*	1.111 *(0.191)*	**1.737*****(0.155)*
There's hope (efficacy)	**0.060***(0.021)*	1.239 *(0.137)*	1.096 *(0.123)*	**1.403*** *(0.172)*	**1.356***(0.140)*
There's hope (opportunity)	**0.048***(0.016)*	0.947 *(0.110)*	1.048 *(0.099)*	0.821 *(0.141)*	0.981*(0.115)*
Political ideology	**−0.140*****(0.018)*	0.841 *(0.114)*	**0.755**** *(0.105)*	1.010 *(0.147)*	**0.721****(0.119)*
Political party	0.063 *(0.016)*	1.211 *(0.108)*	1.019 *(0.095)*	1.226 *(0.150)*	1.148*(0.106)*
Age	**− 0.057***(0.001)*	1.008 *(0.007)*	**1.015*** *(0.006)*	**1.025**** *(0.009)*	1.011*(0.007)*
Gender	**− 0.070**** *(0.036)*	1.384 *(0.239)*	0.937 *(0.213)*	0.736 *(0.302)*	0.860*(0.241)*
Education	− 0.024 *(0.017)*	1.233 *(0.109)*	**1.228*** *(0.100)*	1.012 *(0.143)*	0.897*(0.116)*
Income	**−0.081****(0.012)*	0.971 *(0.077)*	1.082 *(0.070)*	0.992 *(0.097)*	1.036*(0.079)*
Race	0.025 *(0.041)*	0.730 *(0.264)*	0.831 *(0.239)*	0.879 *(0.332)*	1.110*(0.274)*
$^{+}R^2$	0.731	0.528	0.425	0.507	0.617

* < .05, ** < .01, *** < .001. Policy support coefficients are standardized beta coefficients while information seeking, information sharing, past political advocacy behaviors, and political advocacy willingness are odds ratios (O/R). Standard error values are given in parentheses under each coefficient. Desc. = descriptive norms, injunc. = injunctive norms. $^{+}$ For logistic regression, Mplus calculates R^2 as the variance explained in the latent response variable (see Long, 1997)

significantly and positively predicted past political advocacy actions. Age (O/*R* = 1.025, *p* = .007) was the only positively associated and significant demographic variable. Neither political ideology nor political party affiliation were significant in this model.

Three of the six key truths were significant predictors of political advocacy willingness: '*it's us*', '*others care*' (descriptive and injunctive norms), and '*there's hope*' (efficacy). Belief in human causation of global warming (O/*R* = 3.921, *p* < .001), descriptive (O/*R* = 1.422, *p* = .030) and injunctive (O/*R* = 1.737, *p* < .001) norms, and collective efficacy (O/*R* = 1.356, *p* = .028) were all positively associated with political advocacy willingness. No demographic variables were significant in this model. Political ideology was a significant

Table 3 Summary of current belief in the six key truths showing the relative percentage of 'correct' and 'incorrect' beliefs based on the science behind the truth

Key truth	'Correct' belief	'Incorrect' belief
It's real	73.0%	26.9%
It's us	58.6%	33.6%
Experts agree	26.0%	53.5%
It's bad	64.7%	30.1%
Others care (desc.)	38.9%	51.4%
Others care (injunc.)	40.3%	46.2%
There's hope (efficacy)	40.3%	58.6%
There's hope (opportunity)	80.5%	13.8%

Percentages may not total 100% due to missing data

predictor, indicating that those who are more liberal have greater willingness to participate in political advocacy (O/R = .721, p = .005).

3.4 Key truth beliefs across the population

A final result pertains to the assertion from Hornik and Woolf (1999) that beliefs need 'room to move' through strategic communication efforts. Table 3 shows a dichotomized version of each of the key truth variables. The percentage that holds the 'correct' belief are those that hold a belief consistent with scientific understanding (e.g., climate change is happening or that more than 90% of scientists agree it is human caused). The other column represents those not yet holding that belief (i.e., 'incorrect' belief). Table 3 highlights that there are some key truths where there is significant room to move people to the correct belief, such as perceptions of expert consensus and both descriptive and injunctive norms. For most truths, other than '*it's real*' and '*there's hope (opportunity)*', at least one-third of the population holds the incorrect belief.

4 Discussion

This study investigates to what extent understanding six key truths about climate change – '*it's real*', '*it's us*', '*experts agree*', '*it's bad*', '*others care*', and '*there's hope*' – predict important outcomes of climate information seeking and sharing, policy support, and political advocacy. A primary contribution of our study pertains to our choice of variables organized as climate change's six key truths. The approach, articulated by Hornik and Woolf (1999), of starting first by investigating to what extent the variables predict our outcomes of interest was our starting point. Our novel investigation of a range variables (including all six key truths and several outcomes) analyzed together, integrated within the same models, presents value to practitioners communicating climate change for a variety of aims such as improving policy support, encouraging discussion and sharing, and mobilizing political advocacy. Our findings suggest that five of the six key truths are important predictors of at least one – and in some cases most – of the outcomes of interest in promoting public and political will for climate policy solutions. Importantly, our results suggest practitioners would benefit from placing greater or lesser emphasis on certain key truths depending on their communication goals, because certain truths are more predictive of some attitudinal or behavioral outcomes than others. For example, if the goal is to encourage climate change conversation (i.e., information sharing) and political advocacy action, emphasizing social

norms (‘*others care*’) is likely key. Messages that emphasize collective efficacy (‘*there’s hope*’) are likely to also help promote advocacy, and policy support.

Information seeking was positively predicted by descriptive norms, while information sharing was positively predicted by both descriptive and injunctive norms. This suggests that one’s general perception of what others think or approve of may be an important contributor to how much one seeks out and shares information about climate change. Our finding is in line with past literature that has found social norms – particularly the perception of what others *expect* of one’s self – to be a key driving factor for information seeking (Choo 2023). Similarly for information sharing, people tend to be less willing to discuss climate change if they believe their views are in the minority, which can entrench a false social norm that many people do not believe in the reality of climate change when in fact, the opposite is true (Geiger and Swim 2016; Maibach et al. 2016). Hence, our results indicate that social norms are an important factor in encouraging both information seeking and information sharing. Messages emphasizing that it is socially acceptable and common to seek out information about climate change (‘*others care’* descriptive norms) and that information sharing is a socially encouraged thing to do (‘*others care’* injunctive norms) could be a helpful way to frame messaging to encourage information seeking and sharing behaviors. However, we acknowledge that our operationalization of ‘others care’ is not specific to information sharing as an action. Hence, future studies might benefit from operationalizing each key truth in a way that more precisely matches its description. More broadly, our results suggest that messages highlighting that people are not alone in their concern about climate change – i.e., the social normative dimension that ‘*others care’* – may be useful in helping people break through the social barriers related to discussing climate change with others (Fine 2022; Geiger and Swim 2016; Griffin et al. 1999; Kelly et al. 2020; Steg 2023).

Next, we found that support for climate policy was predicted by five of the six key truths: human causation (‘*it’s us’*), expert consensus (‘*experts agree’*), risk perceptions (‘*it’s bad’*), injunctive norms (‘*others care’*), as well as perceived future opportunity (*‘there’s hope’*) and collective efficacy (*‘there’s hope’*). These results are line with other research that has found that support for climate policies is related to many other variables; Drews and van den Bergh (2016) identified at least 20 different socio-psychological, perception-based, and contextual factors that could affect support for climate policies. Our results demonstrate that a variety of key truths about climate change predict support for climate policy. Hence, if a communication goal is to increase support for climate policy, there may be more flexibility available when it comes to crafting messages than for other communication goals. Model coefficients for risk perceptions (‘*it’s bad’*) along with scientific consensus (‘*experts agree’*) are the largest for this model (in comparison to other predictors); suggesting these could be two relatively important targets for persuasion, although this should be tested in future experimental research. There is also a need to better understand whether there are any interdependent relationships between these variables (Tschötschel et al. 2021). Future research could aim to further explore the role the key truths may have in encouraging greater support for climate policy and whether predictors of climate policy support vary based on policy type (e.g., mitigation, energy, or adaptation).

When examining political advocacy, we found that different key truths predicted advocacy willingness and advocacy as a past behavior. We found that human causation (‘*it’s us’*), descriptive and injunctive norms (‘*others care’*), and collective efficacy (‘*there’s hope’*) positively predicted political advocacy willingness. However, only injunctive norms (‘*oth-*

ers care') and collective efficacy (‘*there's hope'*) predicted past political advocacy. These results appear to reflect the notion of the attitude-behavior gap, in which people tend to exhibit higher intentions to take action, but do not actually undertake those actions to the same extent, if at all (Ballew et al. 2024; Kollmuss and Agyeman 2002). Some research suggests this gap can occur as a result of psychological barriers such as perceived costs of taking the action, but may also be affected by structural and informational barriers, among others (Farjam et al. 2019; Grandin et al. 2021; Vieira et al. 2023). Collective efficacy (‘*there's hope'*) significantly predicted both future intentions and past behavior, suggesting that beliefs about whether groups of people acting together can be effective is potentially motivating. This is in line with growing evidence underscoring the role of efficacy beliefs in motivating climate advocacy (Doherty and Webler 2016; Hart and Feldman 2016). It also has implications for communication practice, as messages intended to build collective efficacy could be effective at fostering climate advocacy (Feldman and Hart 2016). Social norms were an additional relevant component explaining political willingness and past behaviors. Emphasizing that *'others care'* is a potentially helpful way to craft messages if the goal is to encourage actions such as political advocacy.

Taken together, the models for all outcomes in this study indicate that social norms (‘*others care*’) stand out as the most consistent predictors. Descriptive norms – statements that capture prevalent behaviors among a group or population – positively predict information seeking and sharing, and political advocacy (willingness as well as past behaviors). Injunctive norms – statements about which behaviors are approved or disapproved – positively predicted information sharing, policy support, and political advocacy willingness. In short, norms robustly predicted actual behavior, which is necessary for building strong public support. We do see that norms are potentially one of the most important key truths – a point also observed in the literature (Campbell et al. 2023; Doherty and Webler 2016; Nilsson et al. 2004; Schneider and van der Linden 2023; Sparkman et al. 2021). However, normative messages can take many forms, for example they could focus on norms about the prevalence of climate concern, how many people support climate action, or how often people are currently taking action. Another form is ‘dynamic norms’, which capture perceptions of how attitudes or behaviors have changed over time (retrospective) or how they may change into the future (prospective) (Sparkman and Walton 2017, 2019). Past studies have shown prospective dynamic norms to positively predict climate advocacy intentions into the future (Campbell et al. 2023). The most effective type of normative message will depend on the goals or intended outcomes of the communication. This provides opportunities for future research to learn more about the causal effects of normative and efficacy appeals in strategic climate messaging (Constantino et al. 2022).

Another important point is that the first key truth, ‘*it's real'*, was not a significant predictor in any model. A potential reason for this is that belief in the existence of climate change has been rising over the past decade and a majority of Americans are now convinced it is happening (Leiserowitz et al. 2023a, b, c). In other words, the existence of climate change is now hard to deny, and it may be that belief certainty is simply not compelling enough a factor on its own when jointly considering other key truths like social norms. There may also be more complex relationships with political identity or urbanicity variables, in other words, the regions where people live. Political ideology is related to a number of our outcomes and future investigations could consider the role of where people are situated, specifically

whether being in an urban center results in any differences compared with someone else who lives in a more rural center.

A primary limitation of our results is that they are correlational, not causal. Although a key truth is positively associated with a persuasive outcome (e.g. policy support, advocacy), it does not guarantee that messages designed to influence that key truth will yield the desired persuasive outcome (O'Keefe 2024). Moreover, we cannot speak to any temporal order of variables or even the possibility of reverse or dual causality. Our study is firmly grounded in exploration and future message research via controlled experimental designs would be a useful next step in helping establish causal relationships (Roser-Renouf and Maibach 2018; van der Linden 2021). Another worthwhile angle of future investigating could involve looking specifically at segments of those who do or do not hold a key belief and then exploring the nature of the other key truths. These findings are specific to the U.S. cultural context because the key truths are grounded in decades of research, a large portion of which is focused on U.S. audiences. However, we acknowledge this as a limitation and as a result, may not be directly applicable in other countries.

We believe we have identified some potentially 'moveable' variables that could be well suited for further investigation and testing in climate messaging experiments and campaigns (Hornik and Woolf 1999). However, more research could be conducted to assess other possible ways of operationalizing these constructs or to explore other potential key truths if they become more salient in the future or for example, including additional variables such as participation in climate protest for the political advocacy outcome. A final thought concerns the second criterion of the Hornik and Woolf (1999) approach, whether there is 'room to move' people to the 'correct position' on a specific belief (e.g., from believing climate will not harm future generations to the correct believe that it will). Years of public opinion tracking on climate change shows a steady increase in beliefs like human causation and risk perceptions, although there is still room to grow (Leiserowitz et al. 2024). Our results indicate that almost all key truths (with the exception of '*it's us*' and '*there's hope (opportunity)*') have around one-third or more of the population that do not hold the 'correct' belief and therefore, practitioners have an opportunity to continue work on shifting these beliefs through strategic messaging. However, it is important to note, attitudes do not always precede behaviors, in fact, literature – as well as our results – suggests there is a gap between what people *say* they are willing to do, and what they *actually* do (Ballew et al. 2024; Fine 2022; Grandin et al. 2021). Encouraging uptake of pro-climate behaviors at personal level and collective level is another key opportunity for climate communication practitioners and we see room for it to increase in the U.S. Our results suggest that, depending on the behavior one is looking to shift, communication must be tailored for that outcome and the key truths can be a useful place to start.

5 Conclusions

One way to craft effective strategic communication is to begin with outcomes of interest and then work backwards to investigate which key variables have the potential to move these outcomes in a desired direction. We applied this method here and investigated whether six key truths of climate change – '*it's real*', '*it's us*', '*experts agree*', '*it's bad*', '*others care*', and '*there's hope*' – could predict policy support, information seeking and sharing, and

political advocacy intentions and behaviors. We found that different key truths positively predicted each outcome, with social norms being the most consistent significant predictors across all models. This indicates that emphasizing different key truths could be a way of tailoring strategic communication to specific attitudinal and behavioral outcomes. This study provides a framework for communication practitioners to consider when crafting messages to influence specific climate-related attitudinal and behavioral outcomes.

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Declarations

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