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The earth is our home: systemic metaphors to redefine our relationship with nature

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Abstract Climate change is one of the most compelling challenges for science communication today. Societal reforms are necessary to reduce the risks posed by a changing climate, yet many people fail to recognize climate change as a serious issue. Unfortunately, the accumulation of scientific data, in itself, has failed to compel the general public on the urgent need for pro-environmental policy action. We argue that certain metaphors for the human-environment relationship can lead people to adopt a more nuanced and responsible conception of their place in the natural world. In two studies, we tested properties of multiple metaphors with the general public (study 1) and experts on climate change (study 2). The metaphor "the earth is our home" resonated with climate experts as well as diverse subpopulations of the general public, including conservatives and climate-change deniers.

1 Introduction

xSignificant societal reforms are necessary to reduce greenhouse gas emissions on a broad scale to avoid impending "tipping points" for irreversible damage as a result of climate change (Bernauer 2013; Cai et al. 2016; Pachauri et al. 2014; Stehr 2015). Unfortunately, the widespread scientific agreement on the anthropocentric origins of and risks posed by climate

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change is paralleled by the widespread apathy among the lay public (Gallup 2015; Leiserowitz et al. 2015).

Simply communicating the scientific evidence for climate change has largely failed to convince the general public of the urgent need for pro-environmental policies (Kahan et al. 2012; McCright and Dunlap 2011; but see van der Linden et al. 2015). Further, discussions of the risks that climate change poses to our current way of life and national security, paradoxically, may make people less willing to counteract climate change (Feinberg and Willer 2011; O'Neill and Nicholson-Cole 2009; but see Feldman et al. 2015). Dire messaging about the potential risks posed by climate change seems to threaten peoples' core beliefs about the world as a just and stable place and, in turn, to discount evidence for global warming (Furnham 2003).

Recent research suggests that shifting the justification for pro-environmental action from a "risk reduction" framework to a "co-benefit" framework may be more successful (Bain et al. 2012, 2016). In the "co-benefit" framework, the argument for implementing pro-environmental policies emphasizes positive economic and health outcomes for humans that would result from taking action, rather than focusing peoples' attention on the risks posed by a changing climate. People may be more motivated to support environmental action that is framed as a gain (to humans and the natural world) rather than as a way to mitigate a loss (Spence and Pidgeon 2010).

There are, however, several open questions about how to best communicate the "co-benefits" of environmental action to the general public. For instance, one recent study found that people were more likely to support pro-environmental policy interventions after they were asked to imagine the societal benefits of taking collective action to prevent climate change (Bain et al. 2016). On the other hand, another study found that simply stating that a set of policy interventions would have a "positive impact on the community" and would "make for a more prosperous and sustainable economy" failed to increase support for the policies (Bernauer and McGrath 2016). These inconsistent findings suggest that some methods for communicating the "co-benefits" of environmental action may be more effective than others.

Here, we argue that metaphors can facilitate climate change messaging campaigns. Certain metaphors for the human-environment relationship may encourage people to adopt a more nuanced and responsible conception of their place in the natural world and to recognize the potential "co-benefits" of environmental action (Lakoff 2010). We first discuss why we think metaphors can be effective tools in climate change communications. Then we review an interdisciplinary construct, systems thinking, which has guided our search for effective metaphors for the human-environment relationship. Finally, we present the results of a study designed to assess the communicative value of a set of metaphors for the human-environment relationship, which included participants from the general public ($N = 993$) and experts on climate change ($N = 235$).

1.1 Metaphor

Metaphors make complex domains cognitively tractable by allowing us to think about them using knowledge structures that are more familiar and accessible (Lakoff and Johnson 1980). Metaphor-based interventions can fundamentally change how people think about complex concepts like crime (Thibodeau and Boroditsky 2011) and intelligence (Dweck 2006). For instance, metaphorically framing crime as a *virus* (compared to a *beast*) makes people more likely to support crime-reduction policies grounded in social reform and less likely to support

harsh enforcement tactics (Thibodeau and Boroditsky 2011). Similarly, describing the brain as a *muscle* leads students to adopt a growth, rather than a fixed, theory of intelligence and to engage in more frequent and deliberate practice of challenging course material (Dweck 2006).

A meta-analysis of framing effects suggests that metaphors are about 6% more persuasive than literal language (Sopory and Dillard 2002) and, historically, metaphors have played an important role in motivating policy initiatives. In the 1980s, for example, President Reagan declared a *war* on drugs, with smugglers, dealers, and users defined as the enemy to be fought (Elwood 1995). Policies in line with the war on drugs mandated longer, harsher sentences for drug-related crimes. Since then, the incarceration rate has more than quadrupled in the USA (Kaeble et al. 2015).

The scientific community and popular media already use metaphors to communicate with the public about complex issues related to climate change (Lakoff 2010; Larson 2011; Nerlich et al. 2010; Princen 2010)—often in a cost-benefit, "ecosystem service," frame (Shaw and Nerlich 2015). Such language provides a simple mental model for thinking about the environment and evaluating policy interventions but may lead people to believe that there are always straightforward trade-offs between sustainable environmental policies and economic growth.

In contrast, consider how Pope Francis recently grounded an appeal for more sustainable and responsible environmental behavior and policy (Francis 2015, p. 3): "Our common home is like a sister with whom we share our life and a beautiful mother who opens her arms to embrace us." In this argument, the premise for addressing climate change is established by situating ourselves as the metaphorical beneficiary and caretaker of the natural world. As a result, it is both more comprehensive, suggesting a broad range of pro-environmental attitudes and behaviors, and less controversial—skirting concepts that have become loaded and may be easily dismissed by people who fail to acknowledge climate science.

For the current study, we reviewed several linguistic analyses of metaphors for the human-environment relationship (e.g., Lakoff 2010; Larson 2011; Nerlich et al. 2010; Princen 2010). From these sources, we selected 17 metaphors to evaluate along three important dimensions. The metaphors included four that personified the earth (*mother*, *parent*, *child*, and *ancestor*), three that mechanized the earth (*spaceship*, *machine*, and *network*), six that highlighted the earth's resources (*bank*, *store*, *market*, *farm*, *investment*, and *gift*), and four that situated the earth spatially (*park*) and/or as an emergent property of a group (*kingdom*, *community*, and *home*). We quantified (a) an affective dimension of the metaphors, (b) how well the metaphors encouraged people to think of the natural world as a complex system, and (c) the accuracy of the metaphors.

One way that metaphors influence people is by evoking emotion. Metaphors are more emotionally evocative than comparable literal expressions (Gibbs 1994). Recent neuroimaging work has found that metaphorical adjectives like "sweet" more strongly engage parts of the brain that encode emotion like the amygdala than non-metaphorical adjectives like "kind" (Citron and Goldberg 2014). As a result, one of our goals was to identify which metaphors for the human-environment relationship are most likely to elicit positive affect.

A second way that metaphors influence how people think is by providing a mental model for thinking about the domains they are used to describe (Lakoff and Johnson 1980). Metaphorically framing crime as a *virus* encourages people to use their knowledge of how to address a literal *virus* epidemic to think about crime reduction—activating ideas of diagnosis, treatment, and social reform in the context of crime (Thibodeau and Boroditsky 2011). Thus, a second important goal in the current study was to identify metaphors that would encourage people to adopt an appropriate mental model of their relationship with the natural

world. Based on a recent work in environmental studies, we sought metaphors that would encourage people to think of the natural world as a complex system (Meadows and Wright 2008). We expand on this idea in the following section.

Finally, communicative metaphors should be accurate. To quantify how accurately the target metaphors portrayed the human-environment relationship, we asked scientists with expertise in climate change to evaluate the metaphors. We also asked participants without expertise in climate change to evaluate the accuracy of the metaphors, and we compare this dimension across the samples. In order for a metaphor to have a pervasive cultural impact, it should be viewed as accurate among experts in the topic and among the target audience.

1.2 Systems thinking

Systems thinking is a cognitive style (a mindset or way of thinking) that acknowledges the emergent complexity of systems like the natural world (Checkland 1981; Meadows and Wright 2008; Thibodeau et al. 2016a). The construct is often taught as part of curricula in environmental studies and business management (Sterman 2010). Core tenets of systems thinking include an emphasis on holism (as opposed to reductionism), an expanded conception of causality (that a vast array of interacting variables are often responsible for specific outcomes in complex systems), and recognition that systems are constantly changing in predictable and unpredictable ways (Meadows and Wright 2008).

Formal tools—both cognitive and technological—have been developed to facilitate "hard" systems thinking, which entails the careful analysis and simulation of systems using statistical models (Checkland 1981). However, there is also a "soft" formulation of the construct that does not require these tools—instead, focusing on a more intuitive and reflective thinking style. On this view, an emphasis on systems thinking may be seen as an attempt to promote a kind of "wisdom" among the general public with regard to environmental decision-making (Schwartz and Sharpe 2010).

Recent work has found that people who are predisposed to think about the human-environment relationship as a complex system are more likely to recognize the risks posed by climate change and the "co-benefits" of pro-environmental action (Lezak and Thibodeau 2016). One reason to be cautiously optimistic about the power of systems thinking to facilitate pro-environmental decision-making is that the mindset may be more malleable than other factors like political ideology that affect peoples' attitudes toward climate change (Hung 2008; Thibodeau et al. 2016b).

Some metaphors seem to encourage systems thinking more naturally than others by inviting people to build a richer, more nuanced representation of the issue being described (Thibodeau et al. 2016b). For example, one way of characterizing the difference between the *virus* and *beast* metaphors for crime is that the *virus* metaphor leads people to build a deeper causal structure of the problem by situating it in a larger body of the community. As a result, the metaphor encourages people to think more about the root causes of crime. In contrast, the *beast* frame identifies a singular agent, the beast, as the cause of the crime problem, and subtly suggests approaches to crime reduction that are analogous to catching and caging the beast: hiring more police officers and sentencing criminals to longer prison sentences. In other words, the *virus* metaphor is more systemic because it activates a mental model of the crime scenario that highlights the complex web of causal relations between elements in the domain rather than isolating a singular causal factor. In the context of climate change messaging, metaphors that encourage systems thinking may help communicate the "co-benefits" of environmental action.

2 The current studies

We developed an initial pool of 17 metaphors for the human-environment relationship by reviewing several linguistic analyses of metaphors for the human-environment relationship (Lakoff 2010; Larson 2011; Princen 2010). Our selection of stimuli was guided by a desire to test a variety of ways of classifying the earth (e.g., some metaphors personified the earth and others mechanized the earth), with nominal metaphors (i.e., using a noun to categorize the earth, as in "The earth is an X"), that had a clear figurative interpretation (see supplementary material for additional discussion of how we choose the pool of metaphors to test). In study 1, participants from the general public evaluated three dimensions of these 17 metaphors: an affective component, a systemic component, and the accuracy of the metaphors (see Fig. 1). We used the results of study 1 to identify a subset of six metaphors for additional testing. In study 2, we asked a group of scientists with expertise in climate change to evaluate these six metaphors.

Across the two studies, we sought to address four research questions. First, which metaphors for the human-environment relationship elicit the most positive affect? Second, which metaphors are most likely to encourage people to think of the natural world as a complex

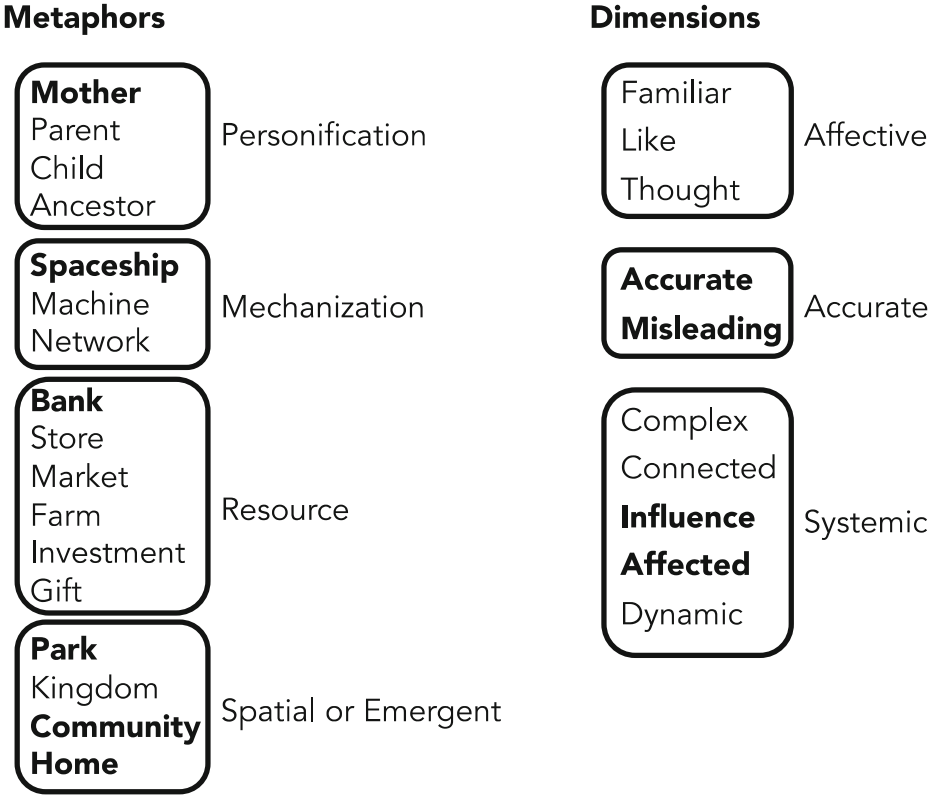

Fig. 1 The 17 metaphors that were evaluated by participants from the general public are shown on the *left*, with the six metaphors that were evaluated by the sample of scientists in *bold*. The 10 rating questions are shown on the *right*, grouped into the three target dimensions; questions that the sample of scientists answered about the metaphors are shown in *bold*

system? Third, which metaphors are viewed as the most accurate and to what extent does a person's knowledge about climate change affects this judgment? Finally, fourth, are the metaphors likely to resonate with some groups of people more than others?

We expected some of the metaphors (e.g., *home*) to elicit more positive affect and to be evaluated as more systemic than others (e.g., *park*; Princen 2010), but there were also several metaphors for which we did not have strong a priori predictions. For instance, the earth is often compared to a *spaceship* in introductory environmental studies textbooks (e.g., "We live on a relatively small planet hurtling through space at about 107,200 kilometers per hour on a fixed course. Although we can never take on any significant amounts of new supplies…"; Miller and Spoolman 1988, p. xxii). This metaphor may or may not facilitate pro-environmental thinking among people who lack relevant scientific training. Similarly, metaphors that compare the earth to a *mother* or describe the earth as a *community* are widespread, but may have specific associations that pose obstacles to their acceptance (e.g., one participant in study 1 identified the "mother" metaphor as their least favorite because it "sounds too New Age-y to me").

2.1 Methods

2.1.1 Participants

Data from two groups of participants were collected: one from the general public (study 1; $N = 993$; $M_{age} = 35$; 38% male; 40% Democrats and 20% Republicans) and one from scientists with expertise in climate change (study 2; $N = 235$; 61% male; 94% academic faculty). Participants from the general public (study 1) were recruited from Amazon's Mechanical Turk (Clifford et al. 2015). Only participants with a good performance rating on prior Turk tasks (an approval rating greater than 90%), who lived in the USA, were allowed to complete the survey.

The climate scientists (study 2) were identified from university department websites (of, e.g., Environmental Studies, Geology, and Environmental Psychology) and from recent publications in journals related to environmental studies ($N = 1962$). An email was sent asking for voluntary participation; it was completed by 235 (12%) of this population within about a week. Of these participants, 69% identified as an expert in environmental studies, 15% identified as an expert in environmental psychology, and 41% identified as an expert in something else (e.g., Agriculture and Ecology).

2.1.2 Materials and design

In study 1, participants were asked 10 rating questions about each of the 17 metaphors. Three of the questions asked about affective qualities of each metaphor: how much people liked the metaphor, whether the metaphor was thought provoking, and how familiar it was. Five questions asked about how well each metaphor conveyed ideas related to systems thinking (e.g., about how complex the metaphor made the earth seem and whether it expressed the idea that humans influence the earth and that humans are affected by the earth). Finally, two questions asked about the accuracy of each metaphor. Participants were also asked about the expected source of the metaphors, as a multiple choice question. Options included: politician, business person, religious leader, scientist, environmental activist, and farmer (participants' were instructed to select all that

applied). The wording of the instructions and target questions is included in the supplementary material.

The order of the 17 metaphors was randomized across participants. Each of the three subcomponents of the scale was measured reliably. Cronbach's alpha was .74, .78, and .76 for the affective, systemic, and accuracy components, respectively. On average, the survey took participants 25 min to complete. In the supplementary material, we present two analyses to confirm that the findings did not result from participants becoming fatigued over the course of the study (section 2.3), and we discuss additional measures of reliability (section 2.2).

After rating the metaphors, participants were asked to identify which of the 17 metaphors they liked the most and which of the 17 metaphors they liked the least. They were asked to provide a brief explanation for these choices in a free response format. Participants were also asked to suggest additional metaphors for the human-environment relationship.

Finally, at the end of the study, participants were asked to complete a series of attitudinal measures that have been linked to perceptions of climate change (see supplementary material section 2.1), as well as background demographic questions, including their age, gender, educational history, and political affiliation. These participants were also asked how knowledgeable they considered themselves about climate change ($M = 2.98$ out of 4, $SD = .56$), whether they thought climate change was the result of human behavior (14% "All" or "Mostly natural causes"; 68% "All" or "Mostly human causes"; 18% "About the same"), and whether they thought there was a scientific consensus on climate change ($M = 74\%$ of scientists agree, $SD = 20.3$; median = 79; mode = 80; range = [0, 100]).

A subset of participants in study 1 ($n = 126$; 13%) were only asked the background and demographic questions in order to test whether exposure to the metaphors systematically affected their responses to questions about, e.g., their belief in global warming. We found no differences between groups on any of these follow-up questions, affording more confidence in the generalizability of the results.

In study 2, scientists with expertise in climate change were asked to evaluate six of the original 17 metaphors: three of the metaphors that scored the highest along the three target dimensions among the general population (*home*, *mother*, and *community*) and three of the metaphors that scored the lowest among the general population (*park*, *spaceship*, and *bank*; see Fig. 1). The order in which these six metaphors were evaluated was randomized across participants.

We were particularly interested in how accurately the scientists thought the metaphors conveyed information about the human-environment relationship. As a result, participants in study 2 were asked about how accurate the metaphors were and how misleading they seemed (reverse scored). They were also asked two questions about how systemic the metaphors were: about how much each metaphor implied that humans affected the earth and about how much the earth affected humans. An item analysis revealed that these two questions were the most representative questions about the systemic-ness of the metaphors (see supplement section 2.2). The measure of accuracy was highly reliable in study 2, Cronbach's alpha = .84; the measure of the systemic-ness of the metaphors was somewhat less reliable in study 2, Cronbach's alpha = .69, although close to the conventional cutoff of .7.

Participants in study 2 were not asked to rate affective qualities of the metaphors. However, they were asked to choose a favorite metaphor, a least favorite metaphor, and to explain these choices; they were also asked to suggest additional metaphors for the human-environment relationship. The survey for study 2 was shorter because we expected the sample of scientists

to have more severe time constraints. Data for both studies have been made available on the Open Science Framework (osf.io/ztk2e).

2.2 Results

2.2.1 Affect

Our first goal was to assess the capacity of the metaphors to evoke positive affect. We investigated this question in two ways. First, we analyzed the ratings data from study 1 (see Table 1). A repeated measures ANOVA revealed that the metaphors differed along this dimension, $F[16, 13856] = 416.90$, $p < .001$. The *home* metaphor was identified as eliciting the most positive affect, significantly more than the *mother* metaphor, which was identified as the eliciting the second-most positive affect, $t[866] = 10.94$, $p < .001$.

Second, we analyzed the frequency with which each metaphor was selected as participants' favorite and least favorite. In study 1, the *home* metaphor was selected as the favorite by 28% of the participants (95% CI = [.25, .31]). Participants also frequently identified the *mother*, *community*, and *gift* metaphors as favorites (see Table 1). Very few participants (1%, 95% CI = [.00, .02]) identified the *home* metaphor as their least favorite.

Among the sample of experts on climate change (study 2; see Table 2 and Fig. 2), 60% of participants identified the *home* metaphor as their favorite (95% CI = [.53, .66]) and only 1% identified the *home* metaphor as their least favorite (95% CI = [.00, .04]).

Together these data suggest that describing the earth as our common *home* elicits the most positive affect. Talking about the earth as our metaphoric *mother*, as a metaphoric *community*, or as a *gift* also seems to express a positive emotional valence. On the other hand, framing the earth as a *bank*, *store*, or *market*—metaphors that describe the earth as a resource—elicits the least positive affect.

Table 1 Mean ratings of 17 metaphors along affective, systemic, and accurate dimensions (with standard deviations in parentheses), as rated by participants from the general public (study 1).The percentage of participants who identified each metaphor as their favorite or least favorite metaphor is shown in the two rightmost columns

	Affect	Systemic	Accurate	Favorite	Least
Home	5.36 (1.10)	5.12 (0.98)	6.17 (1.11)	28%	1%
Mother	4.87 (1.33)	4.94 (1.11)	5.08 (1.55)	13%	2%
Community	4.35 (1.34)	4.99 (1.10)	5.35 (1.32)	9%	1%
Gift	4.38 (1.44)	4.48 (1.28)	5.05 (1.61)	16%	2%
Investment	3.88 (1.44)	4.74 (1.23)	4.93 (1.56)	6%	2%
Network	3.71 (1.45)	4.78 (1.29)	4.90 (1.53)	6%	2%
Farm	3.53 (1.26)	4.50 (1.08)	4.79 (1.46)	1%	1%
Parent	3.65 (1.43)	4.48 (1.14)	4.44 (1.59)	1%	1%
Child	3.57 (1.46)	4.64 (1.28)	4.24 (1.71)	4%	3%
Ancestor	3.49 (1.48)	4.30 (1.33)	4.34 (1.66)	2%	3%
Kingdom	3.77 (1.46)	4.22 (1.28)	4.13 (1.70)	5%	7%
Machine	3.04 (1.37)	3.90 (1.25)	3.72 (1.63)	1%	12%
Market	2.87 (1.32)	3.86 (1.23)	3.77 (1.65)	0%	5%
Store	2.47 (1.23)	3.38 (1.29)	3.27 (1.66)	0%	14%
Park	3.02 (1.29)	3.71 (1.18)	4.01 (1.57)	1%	1%
Spaceship	2.95 (1.66)	3.60 (1.35)	3.43 (1.85)	6%	27%
Bank	2.37 (1.27)	3.32 (1.32)	3.15 (1.64)	0%	17%

Table 2 Mean ratings of six metaphors along systemic and aptness dimensions (with standard deviations in parentheses), as rated by scientists (study 2).The percentage of participants who identified each metaphor as their favorite or least favorite metaphor is shown in the two rightmost columns

	Systemic	Accurate	Favorite	Least
Home	5.11 (1.24)	6.09 (1.11)	60%	1%
Mother	3.93 (1.54)	4.04 (1.69)	9%	6%
Community	4.09 (1.58)	4.46 (1.63)	16%	3%
Park	3.09 (1.42)	2.59 (1.39)	1%	23%
Spaceship	3.26 (1.63)	3.74 (1.82)	12%	19%
Bank	3.08 (1.62)	2.78 (1.68)	3%	47%

2.2.2 Systemic

Our second goal was to identify which metaphors were the most likely to encourage people to think of the earth as a complex system. A repeated measures ANOVA revealed that the metaphors differed from one another along this dimension, $F[16, 13856] = 251.40$, $p < .001$ (see Table 1). The *home* metaphor was rated as the most systemic, significantly more than the *community* metaphor, which was rated as the second-most systemic, $t[866] = 3.40$, $p < .001$.

In study 2, the climate experts rated two of the five questions that were designed to measure how systemic the metaphors were (see Table 2). A repeated measures ANOVA revealed that the metaphors differed along this dimension, $F[5, 1018] = 85.00$, $p < .001$. The *home* and

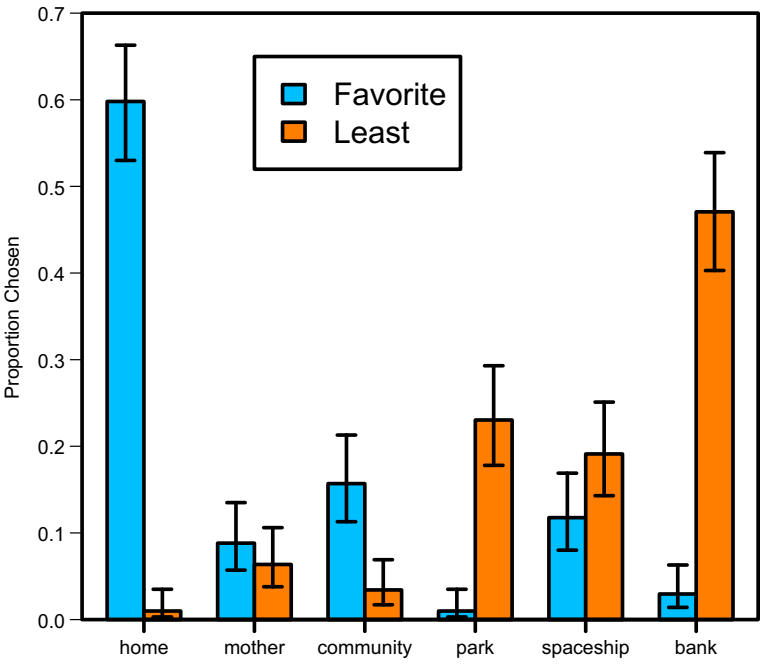

Fig. 2 The most- and least-liked metaphors, according to the sample of scientists. *Error bars* reflect 95% confidence intervals

community metaphors received the highest ratings, with the *home* metaphor receiving a significantly higher score than the *community* metaphor, $t[204] = 9.31$, $p < .001$.

2.2.3 Accuracy

A third goal was to quantify how accurately the metaphors portrayed the human-environment relationship. We first analyze data collected from study 2 from participants with expertise in climate change (see Table 2). A repeated measures ANOVA revealed that the metaphors differed in how accurately they portrayed the human-environment relationship, $F[5, 1018] = 5.41$, $p < .001$. The *home* metaphor was viewed as the most accurate, significantly more than the *community* metaphor, which was rated as the second-most accurate, $t[204] = 3.82$, $p < .001$.

We also compared ratings of how accurate the metaphors were viewed across the two samples—for the six metaphors that were rated by both groups. A mixed effects ANOVA revealed a main effect of sample, $F[1, 1062] = 76.79$, $p < .001$; a main effect of metaphor, $F[5, 5310] = 727.78$, $p < .001$; and an interaction between these factors, $F[5, 5310] = 32.28$, $p < .001$. Overall, participants from the general public (study 1; $M = 4.53$, SD = 1.87) thought the metaphors were more accurate than participants who were experts in climate change (study 2; $M = 3.97$, SD = 1.93): this tendency can be seen in the ratings of the *mother*, *community*, *park*, and *bank* metaphors, ts > 2.6, ps < .01 (see Fig. 3). However, the two groups thought the *home* metaphor was similarly accurate, $t[1062] = .87$, $p = .38$, suggesting that this metaphor may be particularly useful in communication, while the sample of experts thought that the *spaceship* metaphor was more accurate than participants from the general public,

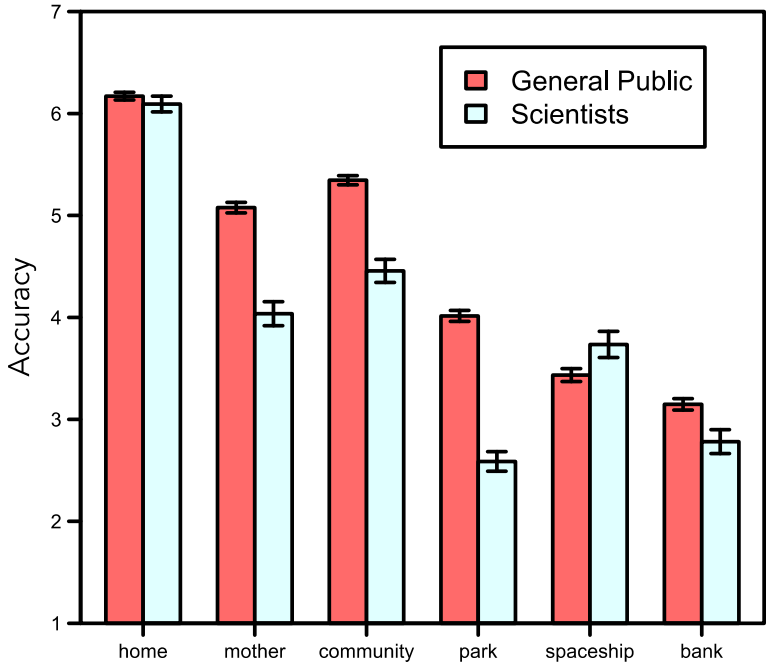

Fig. 3 Mean accuracy of the six metaphors that were evaluated by both samples of participants. *Error bars* denote standard errors of the means

$t[1062] = 2.18$, $p = .03$. The prevalence of the *spaceship* metaphor in, e.g., environmental studies textbooks may lead people with an expertise on climate change to see more value in this metaphor than people from the general public (Fig. 4).

2.2.4 Individual differences

A fourth goal was to test whether evaluations of the metaphors differed as a function of demographic characteristics and ideological worldviews of the participants. We tested this question in two ways with data collected from study 1, since the general public is the target audience for climate change messaging campaigns. First, we investigated whether ratings of the metaphors were affected by participants' gender, political affiliation, age, religiosity, free market ideation, conspiratorial ideation, or belief in global warming. For brevity, these analyses are presented in the supplementary material (section 2.4). One of the primary take-away findings from this analysis is that participants of all backgrounds evaluated the *home* metaphor favorably. This was not true for some of the other metaphors. For example, there was no difference in how Democrats, Independents, and Republicans evaluated the *home* metaphor. However, there were differences in how these groups evaluated the *mother* and *community* metaphors: Republicans did not like these latter metaphors as much as Democrats or Independents.

Second, we investigated who participants in study 1 thought would use the metaphors. One indicator of a metaphor's potential resonance can be seen in whom participants would expect to use it. A repeated measures logistic regression revealed that participants thought the *home*

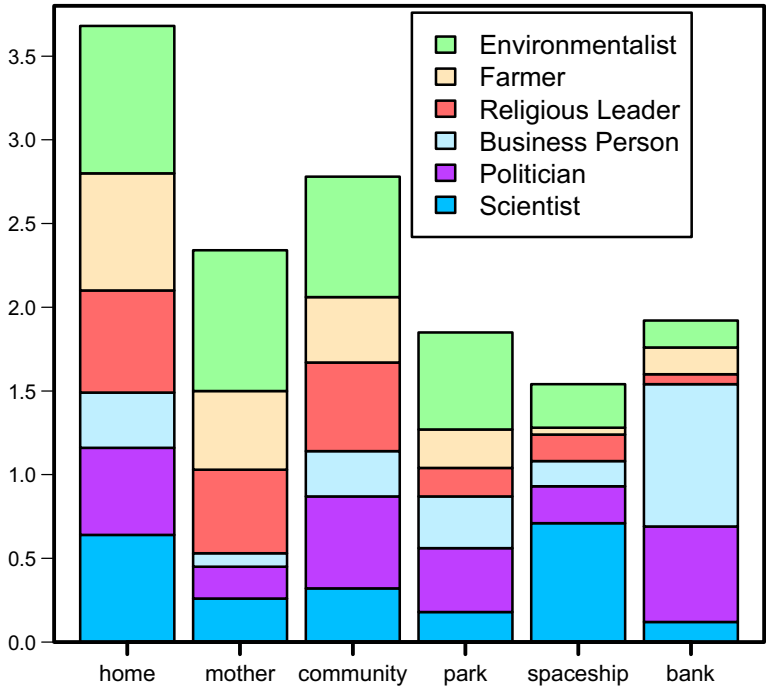

Fig. 4 Expected source of metaphors for the human-environment relationship

metaphor would be used most frequently—significantly more than any of the other metaphors, $zs > 17$, $ps < .001$—and that it was consistent with the language of scientists, politicians, business people, religious leaders, farmers, and environmentalists. The *community* and *mother* metaphors were the next most frequently identified as likely to be used by these sources.

2.2.5 Explanations

Finally, we describe some of the themes that emerged in participants' explanations for liking and disliking certain metaphors. As noted above, these data are available on the Open Science Framework (osf.io/ztk2e).

People who liked the *mother* metaphor emphasized that it highlighted how the earth nourishes humans, that the earth supports humans, and that it implied that humans *should* love the earth in return. Participants who liked the *mother* metaphor often referenced the mythological mother earth, Gaia (Primavesi 2008). However, people who disliked the metaphor thought it was overly anthropomorphic, feminine, and unidirectional (focused on what humans receive from the earth, and only weakly suggesting that humans are caretakers of the earth).

People who liked the *home* metaphor thought it was the most accurate, that it captured the reciprocal nature of the relationship, and carried the least "baggage." People who disliked this metaphor thought it may be too familiar to facilitate a novel way of thinking about the human-environment relationship.

Participants who liked the *community* metaphor thought it accurately drew attention to the interconnectedness of people in different parts of the world and that the metaphor implied that the human-earth relationship was dynamic and self-organizing. On the other hand, some thought this metaphor was too anthropomorphic and restrictive.

The *spaceship* metaphor was also chosen as the favorite by several people, who liked that it highlighted the fragility (e.g., need for maintenance) and bounded-ness of the earth. But several people commented that it made the earth seem man-made, that it implied that the earth is moving toward some destination, and that the human-earth relationship could be construed as an adventure in the framework of this metaphor.

Finally, participants generally disliked the *park* and *bank* metaphors, often noting that both seemed to devalue the actual worth of the environment.

3 General discussion

The widespread scientific agreement on the reality and anthropocentric origins of climate change is paralleled by widespread apathy among the lay public (Leiserowitz et al. 2015). We have argued that certain metaphors—that highlight the "co-benefits" of a healthy environment for humans and the natural world (Bain et al. 2016; Myers et al. 2012; Petrovic et al. 2014), characterize the earth as a complex system (Thibodeau et al. 2016a), and resonate broadly among people with varying worldviews (Burgess 2014)—are especially likely to bridge the gap between how scientists and the general public think about the issue.

In the current study, we found that some metaphors (*home*, in particular, but also *mother* and *community*) were seen as more systemic than others (*park*, *spaceship*, and *bank*). Metaphors that describe the earth as a complex system avoid overly reductionist conceptions of the earth as an "ecosystem service" (Shaw and Nerlich 2015). These systemic metaphors

were also viewed as more accurate and tended to elicit the most positive affect—among a wider spectrum of the population.

One limitation of the study is that it relied on self-report data and correlational measures. Although the current work does go beyond several existing linguistic analyses of environmental metaphors (e.g., Lakoff 2010; Larson 2011; Nerlich et al. 2010; Princen 2010; Shaw and Nerlich 2015) by gauging a broader base of intuitions about them (see Keysar and Bly 1995), an important next step in this research program is to test whether these metaphors actually influence how people think about their relationship with the natural world.

3.1 Conclusions

The global nature of the economic, social, and biophysical systems that sustains us, combined with a burgeoning population whose needs have nearly reached the carrying capacity of the earth, means that failures to operate effectively in these systems have enormous costs. Here, we have argued that changing the dominant patterns of language—metaphors in particular—for environmental issues may be critical for increasing a broad-based support for pro-environmental policy interventions. Metaphors are powerful tools for thinking about complex issues and can facilitate cultural change. In the context of climate change communication, systemic metaphors for the human-environment relationship may provide simple and scalable methods of increasing systems thinking and enhancing everyday decision-making that do not require extensive training or cognitive resources.

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Compliance with ethical standards

Competing interests The authors declare that they have no competing financial interests.

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