Message framing influences perceived climate change competence, engagement, and behavioral intentions

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A B S T R A C T

The effect of motivational versus sacrifice message framing on perceived climate change competence, engagement, and 15 mitigative behavioral intentions was examined in a large Canadian community sample ($n = 1038$). Perceived competence, engagement, and several behavioral intentions were significantly greater after exposure to motivational framing than after sacrifice framing. Gender, age, income, and educational level moderated some results, and moral engagement and agentic language also played a role. The results support the use of motivational frames rather than sacrifice frames to increase the climate-related engagement and activation of community members.

1. Introduction

If climate change is to be mitigated, global emissions should not exceed the capacity of the biosphere to absorb them. One IPCC projection is for a 2 °C warming. To avoid that level of warming or more, global emissions must peak by 2015 and fall by 50–85% by 2050, an important threshold for ecosystems and people (IPCC, 2007). However, rather than declining, global emissions are projected to climb almost 60% by 2025 (World Resources Institute, 2008).

To achieve reductions relatively soon, new forms of discourse to support the emergence of a sustainability ethic will be required (Bandura, 2007; Corbett, 2006; Dale, 2005; Dietz et al., 1999; Jamieson, 2007, 2008; Leiserowitz and Fernandez, 2007; Moser and Dilling, 2007b; Phoenix, 2006). Social scientists, policy-makers, and non-governmental organizations are grappling with the question of how to increase citizen engagement in climate change issues (e.g., Dale and Onyx, 2005; Dilling and Moser, 2007). The primary purpose of this study was to assist in this effort by comparing the efficacy, in a large representative community sample, of message frames that emphasize sacrifice with those that emphasize motivation.

Households are one important target segment for attempts to reduce greenhouse gas emissions. Household energy use signifi-

cantly contributes to greenhouse gas emissions. For instance, in the United States, households account for about 32% of total energy use (Gardner and Stern, 2002). Apart from this direct use, households also use energy in many indirect ways, for example in the production, transportation, and disposal of goods and services (e.g., Vringer and Blok, 1995). In the Netherlands, for example, about 45% of total energy use by households involves direct energy use and about 55% involves indirect energy use (Noorman and Schoot Uiterkamp, 1998; Vringer and Blok, 1995).

Global climate change is a diffuse phenomenon that can even involve temporary local cooling, one that can seem beyond the control of individuals. Therefore, one would expect that an element of empowerment is required if social mobilization is to be achieved. To date, little evidence supports this statement, although studies with children suggest that increasing their knowledge can add to their sense of empowerment (Devine-Wright et al., 2004; Taber and Taylor, 2009). Messaging can be an important key to success in this endeavor.

1.1. Framing

Message framing refers to communication in words, images, and phrases for the purposes of relaying information about an issue or event (Chong and Druckman, 2007). Frames can be used to define problems, suggest who is responsible or guilty, and what the most effective solution might be (Corbett, 2006; Cox, 2006; McComas et al., 2001; Shanahan and Good, 2000). The present study primarily investigates the effect of sacrifice-oriented versus

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motivational-oriented message framing on priming the perceived competence, engagement, and intent to act on climate change of a general population. Demographic variations and the role of moral engagement are also considered.

1.2. Sacrifice versus motivational framing

A number of guidelines and strategies for effectively communicating climate change issues have begun to emerge (e.g., NESTA, 2008). Among these is the suggestion that messages should portray the possible benefits to the individual of climate action, such as positive changes in lifestyle and subsequent improvements in quality of life, rather than sacrifice or fear appeals. Some writers have begun to challenge environmental and governmental organizations for their frequent use of sacrifice-oriented messages and communications (e.g., Nordhaus and Shellenberger, 2007). For example, shifting discourse toward a motivational-oriented approach that involves "solutions, values, and visions" instead of sacrifices by citizens has been proposed as a more effective strategy for encouraging climate-change-related behaviors (Moser and Dilling, 2007a, p. 496). However, to the best of our knowledge, no previous study has empirically demonstrated this, particularly in a large community sample.

1.3. Objectives

This study evaluated the influence of two environmental message frames (motivational or sacrifice, and a control condition) on perceived competence, engagement, and behavioral intentions for a series of residence- and transportation-based mitigative behaviors.

Hypothesis 1. Exposure to motivational framing will be associated with greater perceived competence to deal with climate change than will exposure to sacrifice framing.

Hypothesis 2. Exposure to motivational framing will be associated with greater climate change engagement than will exposure to sacrifice framing.

Hypothesis 3. Exposure to motivational framing will be associated with stronger intentions to change home- and transportation-based mitigative behaviors than will exposure to sacrifice framing.

Hypothesis 4. Demographic factors will (a) moderate the influence of priming frame on perceived competence, engagement, and behavioral intentions, and (b) be associated with variations in climate-related concern, knowledge, competence, engagement, and intentions.

Hypothesis 5. Motivational-oriented requests for justifications of pro-environmental behavior will elicit stronger elements of moral engagement than will sacrifice-oriented requests.

2. Methods

2.1. Overview

The study employed both quantitative and qualitative methodologies. An online questionnaire was used to administer the motivational and sacrifice priming frame conditions, plus a control condition in which neither frame was presented. The respondents were queried on their climate change concern, knowledge, perceived competence, engagement, intention to adopt a series of mitigative behaviors, and demographic items. The priming frame conditions were placed after the concern and knowledge

items and before the perceived competence, engagement, and behavioral intention items. Apart from the three framing variations, the questionnaire was identical for each group.

2.2. Participants

The participants were 1038 (502 male and 536 female) residents of the province of Ontario, Canada.[1] To recruit them, a random sample representative of the Ontario population that balanced gender, age, and regional distribution was purchased from a commercial polling organization. The population of Ontario is approximately 12 million. For this population size, with $p < .05$ and a significance interval of 3%, a sample size of 1067 is required (www.surveysystem.com/sscalc.htm). The study's sample size of 1038 was, therefore, sufficient to meet these requirements.

The survey was sent via a link in an email message in April, 2008. The questionnaire was tested through a "soft launch" with 100 participants. When no issues related to respondent understanding of the items, privacy, etc., arose, the full instrument was launched and continued until enough were received to meet the requirements of a random sample (i.e., the provincial averages for age, gender, and regional distribution). The sample objectives were achieved within one week.

The respondents' ages ranged from 18 to 81, with an average of 43.40 years and a standard deviation of 14.49 years. Seventy-eight percent had more than a high school education. Sixty-three percent owned their homes, and 49% had an annual household income of more than C$60,000. They were randomly assigned to one of three conditions: sacrifice priming ($n = 369$), motivational priming ($n = 344$), or a no-priming control ($n = 325$). The groups did not significantly differ in gender, age, education, income, or owning versus renting their residence.

2.3. Measures

2.3.1. Concern and knowledge

First, climate change concern was measured on a seven-point scale: "How concerned are you about climate change?" (1 = "not at all concerned" to 7 = "very concerned"). Second, factual knowledge about climate change was measured by two items, one about the causes of global warming (6 choices: emissions from power plants, thinning ozone layer, air pollution, carbon dioxide and other greenhouse gases, industrial chemicals, and do not know), and one about the processes leading to it (5 choices: carbon-based gases trapping heat at the Earth's surface, letting more of the sun's heat into the Earth's atmosphere through a thinner ozone layer, chemical reactions using up the air's oxygen, pollution changing the chemical makeup of the air, and do not know).

2.3.2. Sacrifice or motivational priming

Next, the priming was accomplished by presenting the respondents with four items to consider. The sacrifice items were designed to clearly state the case for individual sacrifice that seems present when climate change solutions are discussed within the context of a consumer culture, particularly as presented in the media. Rather than hint at sacrifice, the items were explicit: "To stop climate change, I have to make sacrifices," "I am going to have to get used to driving less, turning off the lights, and turning down the heat," "I am going to have less money in my pocket because solving climate change is going to make energy and everything else

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[1] Careless responding was monitored by the amount of time taken to complete a check question that instructed respondents to select a particular response. This procedure resulted in the removal of data from some individuals. Others did not complete the survey and so their data was dropped.

I buy more expensive," and "I am going to have less freedom to make the choices I want if we are going to solve climate change."

The motivational items were designed to represent the social capital and collective motivation that stakeholders claim are benefits from mitigating climate change. These items, in contrast to the "I" focus in the sacrificial frames, deliberately focus instead on the relational "we" as part of their motivational tenor. They were: "We help solve climate change when we take transit, compost, or buy green energy," "The economy will be stronger if we act first to cut greenhouse gases," "My neighborhood will be a healthier place to live if we walk more to cut greenhouse gases," and "I know someone who lowered their energy bills and I can too." The framing items were answered on a seven-point Likert-type scale (1 = "strongly agree" to 7 = "strongly disagree"). These framing items were followed by items measuring perceived climate change competence, engagement, intentions to engage in mitigative behaviors, and moral reasoning.

2.3.3. Perceived competence

The competence items consisted of six statements about the respondent's competence to engage in pro-environmental behaviors that could reduce greenhouse gas emissions. Three were adapted from the Perceived Competence Scales (Deci and Ryan, 2004). They were: "I can improve my ability to cut my greenhouse gas emissions," "I can move faster to stop global warming," and "I feel able to meet the challenge of controlling the greenhouse gases that I am responsible for." Three further items, using the verbs *shrink*, *grow*, and *break*, were included because they are associated with "causative construction" and represent a "change of state" initiated by the speaker (Pinker, 2007, p. 69). These were "I can shrink my contribution to global warming," "I can grow my contribution to environmental solutions," and "I can break through the barriers that prevent me from addressing global warming."[2] Participants rated their degree of agreement with each item on a seven-point Likert scale (1 = "strongly agree" to 7 = "strongly disagree").

2.3.4. Climate change engagement

Participants rated their degree of agreement with each of 5 engagement statements on a seven-point scale (1 = "strongly agree" to 7 = "strongly disagree"). These were "I talk to my friends about environmental solutions," "I want to know more about what to do to stop global warming," "I feel guilty that I am not doing more to stop global warming," "I have no choice about my contribution to global warming" (reversed) and "News reports on environmental issues make me feel helpless" (reversed).

2.3.5. Behavioral intentions

Fifteen items concerned the intent to act pro-environmentally over the next year, on 12 residential and 3 transportation behaviors. The household actions were: Switch off lights when not in use, buy new appliances that are energy efficient (with Energy Star label), set thermostat at 20 °C or lower in winter, replace/clean furnace filters regularly, install energy-efficient windows, buy local foods when possible, eat vegetarian meals,

sign up with the power company for energy from renewable resources, wash and dry only full loads, install low-flow shower heads, recycle more, and compost. The transportation-related actions were: Buy or lease a fuel-efficient vehicle, get around without a car (walk, bike, bus, carpool) when possible, and check tire pressure once a month or more. The response options for these 15 items were 1 = "definitely," 2 = "probably," 3 = "probably not," 4 = "I already do this," and 5 = "does not apply to me."

2.3.6. Moral reasoning

Two open-ended items explored rationales for acting or not acting to help reduce climate change. They were: "I would do more about climate change but..." and "I can do something about global warming because..." Two coding schemes were used to categorize the responses.

3. Results

3.1. Concern and Knowledge

The sample as a whole was quite concerned about climate change; on the 7-point scale from "not at all concerned" to "very concerned" the mean was 5.24 (SD = 1.53); just over three-quarters (75.4%) answered 5, 6, or 7. The means for the three framing conditions were very similar and not significantly different: 5.26 (motivational), 5.12 (sacrifice), and 5.34 (control), $p > .05$. The knowledge means for the three framing conditions were also very similar and not significantly different ($p > .05$): 37% answered both questions correctly in the sacrifice condition, 38% answered both correctly in the motivation condition, and 38% answered both correctly in the control condition. In the three conditions, 29%, 27%, and 28%, respectively, answered one of the two questions correctly.

Fifty-seven percent of the respondents (as a whole) correctly identified carbon dioxide and other greenhouse gases as the cause of climate change, and 25% believed that the thinning of the ozone layer is the cause. Forty-six percent correctly identified carbon-based gases trapping heat at the Earth's surface as the main process driving climate change. Thirty-six percent believed that letting more of the sun's heat into the Earth's atmosphere through a thinner ozone layer is the main process behind climate change, and 19% either did not know or believed that the process relates to chemical reactions using up the air's oxygen, or pollution changing the chemical makeup of the air.

3.2. Hypothesis 1: framing and perceived competence

First, Cronbach's alpha was used to examine the reliability of the perceived competence scale. Alpha assesses the internal consistency of a scale, that is, how coherently the chosen items measure the construct. For the six items of the competence scale, alpha was .83, which is very good. The scale mean was 2.83 on the 7-point scale, that is, closest to "somewhat agree" (recall that lower scores indicate greater perceived competence).

Hypothesis 1 proposed that being primed with motivational messages would result in greater perceived competence than would being primed with sacrifice messages. The perceived competence of the respondents who received the motivational prime was greater (M = 2.66, SD = .94) than that of the respondents who received the sacrifice prime (M = 2.97, SD = 1.02) $t(706) = 4.25$, $p < .001$. Thus, Hypothesis 1 was supported: perceived competence was stronger for participants who were primed by the motivational items for those who were primed by the sacrifice items. Also, as expected, among the individual items, this trend was generally stronger in response to the competence items that included the "causative construction" verbs: the *F-*

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[2] Pinker (2007) describes two kinds of verbs: more passive ones that imply manner or posture (e.g., improve, meet, or move) and more active ones that imply a change of state (e.g., shrink, break, or grow). The latter are said to be causative, closely linking cause and effect cognitively and implying free will. Thus, a sentence like: "I can shrink my contribution to global warming" is agentic, directly linking the subject to the object and potentially triggering moral thinking. The competence items in this study were formulated to learn whether active, causative verbs influence perceived competence more than passive verbs (improve, meet, and move). Given this study's focus on intended behavior change, the three change-of-state verbs were included to examine their potential effects compared to the three more-passive verbs used in the other items.

values for the items using "shrink," "break," and "grow" were 20.12, 7.98, and 4.65, respectively, whereas those for "improve," "move," and "meet" were .47, 6.49, and 1.27.

As expected, the no-priming control condition produced intermediate levels of perceived competence ($M = 2.83$, $SD = .96$). Duncan's multiple range test revealed that the motivational prime resulted in significantly greater perceived competence ($p < .05$) than the no-priming control condition and that the sacrifice condition produced a marginally significant ($p = .06$) reduction in perceived competence compared to the no-priming condition.

3.3. Hypothesis 2: framing and climate change engagement

The climate change engagement scale originally consisted of five items. Three of these, "I talk to my friends about environmental solutions," "I want to know more about what to do to stop global warming," and "I feel guilty that I am not doing more to stop global warming," formed a reasonably reliable scale (alpha = .74). The overall mean was 3.20 on the 7-point scale.

Climate change engagement significantly differed with message frame, $t(706) = 3.55$, $p < .001$; respondents in the motivational frame condition ($M = 3.02$, $SD = 1.23$) reported stronger climate change engagement than those in the sacrifice condition ($M = 3.67$, $SD = 1.33$). Thus, Hypothesis 2 was supported.

The mean for respondents in the no-priming control condition was intermediate, as expected ($M = 3.18$, $SD = 1.22$). The Duncan's multiple range test showed that climate change engagement in the priming conditions was in the predicted direction, although the differences from the no-priming condition were only marginally significant ($p = .10$ for the motivational prime and $p = .057$ for the sacrifice prime).

3.4. Hypothesis 3: framing and behavioral intentions

Respondents who reported that they already engaged in a behavior or that it did not apply to them were excluded from these analyses because the focus of the study was on behavior change after exposure to the priming frames among those who had not yet adopted mitigative behaviors. These respondents answered 1 ("definitely"), 2 ("probably"), or 3 ("probably not") to signify their willingness to adopt each behavior within one year. Behavioral intention could not be formed into a scale because the number of respondents who already engaged in a particular behavior or believed that it did not apply to them was so variable across the 15 behaviors that few cases would have been left for analysis if only those respondents whose intentions (as opposed to "already do it" and "does not apply to me" responses) on all items were included in a 15-item scale. Therefore, each behavioral intention was analysed separately.

When primed with motivational frames, the respondents' intentions to change their behavior over the next year were significantly stronger, in comparison to those of respondents who were primed by sacrifice items, for five behaviors and were marginally significantly stronger for two other behaviors. The five behaviors were to install energy-efficient windows, $t(711) = 2.62$, $p = .009$, to buy new energy-efficient appliances, $t(711) = 2.8$, $p = .004$, to sign up with a power company that offers energy from renewable resources $t(711) = 3.03$, $p = .003$, to check the car's tire pressure once a month, $t(711) = 2.19$, $p = .029$, and to get around without a car when possible $t(711) = 1.96$, $p = .05$. The two marginally significant behaviors were to buy local foods when possible, $t(711) = 1.93$, $p = .054$, and to set the thermostat at 20 °C or lower in winter, $t(711) = 1.71$, $p = .087$.

Although these intentions to change behavior differed significantly from each other when the two message primes were presented, not all differed significantly from the no-priming

control condition. Based on Duncan's multiple range tests, for energy-efficient appliances, installing energy-efficient windows, checking tire pressure, and getting around without a car, neither priming condition resulted in significant differences from the no-priming control condition. However, in the case of signing up for renewable power, the motivation prime did significantly differ from the control condition, in the expected direction.

3.5. Hypothesis 4: demographic differences

The two-part Hypothesis 4 proposed that (a) the relation between framing condition and perceived competence, climate change engagement, and behavioral intentions would be moderated by demographic factors and (b) concern, knowledge, perceived competence, engagement, and behavioral intentions would vary with demographic factors. Five demographic factors were considered: gender, age, education, household income, and housing tenure (renting versus owning).

3.5.1. Framing, perceived competence, and climate change engagement

Perceived competence was examined as a function of motivational versus sacrifice priming in an analysis of variance that considered the five demographic variables as covariates. Priming was significant, as described earlier: across all respondents, motivational priming ($M = 2.68$) resulted in greater perceived competence to deal with climate change than did sacrifice priming ($M = 2.99$).

Two demographic factors acted as significant covariates: gender and age. Women reported greater perceived competence, $M = 2.75$, than did men, $M = 2.92$ ($p = .002$), and perceived competence steadily declined with age, $Ms = 2.63$ for respondents aged 18–24, 2.67 for 25–34 s, 2.86 for 35–44 s, 2.82 for 45–54 s, 2.87 for 55–65 s, and 3.15 for over 65 s ($p = .014$). In a significant interaction, women's perceived competence was less affected by frame ($M = 2.70$ for the motivation frame and $M = 2.79$ for the sacrifice frame) than was men's ($M = 2.65$ for the motivation frame and $M = 3.19$ for the sacrifice frame), a difference of .09 for women and .54 for men. This change in perceived competence for men (using the control condition as a neutral point) was a .31 increase in the motivation condition and a .23 decrease in the sacrifice condition.

Similar analyses were conducted for climate change engagement. Priming was significant, as described earlier: motivational priming ($M = 3.02$) resulted in greater climate change engagement than did sacrifice priming ($M = 3.37$). The only significant covariate was gender. The engagement of women was greater than that of men in both priming conditions ($M = 2.85$ versus $M = 3.20$ in the motivational condition and $M = 2.99$ versus $M = 3.77$ in the sacrifice condition), and it changed less across conditions (a difference of .14 for women and .57 for men).

Again, women were less affected by the framing than men; their shift in climate change engagement from sacrifice to motivation priming was only .14, whereas that for men was .57. The men's change (from the no-message condition mean) was a .33 decline in climate change engagement when exposed to the sacrifice prime and a .24 increase in climate change engagement when exposed to the motivation frame.

3.5.2. Concern, knowledge, perceived competence, engagement, and behavioral intentions

The second part of Hypothesis 4 was that these variables would vary with demographic factors. This hypothesis was most often supported by gender and age.

Women ($M = 5.47$, $SD = 1.31$) reported more concern about global warming than did men ($M = 5.00$, $SD = 1.70$); $t(1035) = 5.00$,

$p < .001$), and more guilt ($M = 3.38$, $SD = 1.50$ versus men's $M = 4.01$, $SD = 1.80$); $t(1035) = 6.18$, $p < .001$), but they were less well-informed than men about the causes and processes of climate change: fewer women (48%) than men (67%) correctly identified carbon dioxide and other greenhouse gases as causes of global warming, and fewer women (36%) than men (56%) correctly identified carbon-based gases trapping heat at the Earth's surface as the main process behind global warming.

As for intentions to improve residential behaviors, women expressed stronger intentions than men to switch lights off when they are not in use, to buy local foods when possible, to eat vegetarian meals, to wash and dry only full loads, and to recycle more. Among transport intentions, men expressed stronger intentions than women to get around without a car (all $ps < .01$)

Older respondents reported stronger intentions than younger respondents to change 7 of the 15 behaviors: to buy new energy-efficient appliances, set the thermostat at 20 °C or lower in winter, replace or clean furnace filters regularly, install energy-efficient windows, buy local foods when possible, install low-flow shower heads, and compost more (all $ps < .01$).

More educated respondents more often correctly answered that carbon-based gases trapping heat at the Earth's surface are the main process behind global warming ($r = .12$, $p < .001$). However, the more educated respondents did not express greater stronger intentions for any behavior change; in fact, they expressed weaker intentions to wash and dry full loads.

Respondents from higher-income households were more likely to choose the correct answers to the two knowledge items, but lower-income participants expressed stronger intentions to change 4 behaviors: to eat vegetarian meals, sign up with the power company for energy from renewable resources, wash and dry full loads, and get around without a car (all $ps < .01$).

Renters reported stronger intentions than owners to change 4 behaviors: to sign up with the power company for energy from renewable resources, to buy or lease a fuel-efficient vehicle, to get around without a car, and to check tire pressure once a month or more (all $ps < .01$).

3.6. Hypothesis 5: moral engagement

Two open-ended items assessed how participants understood their reasons for acting on climate change (moral engagement) or not (moral disengagement; cf. Bandura, 2007). A coding scheme for the first open-ended question, "I would do something about climate change *but...*" was developed from moral disengagement theory (Bandura, 2007). Most responses fell into one of three categories: exonerative social comparison (22%), displacement and diffusion of responsibility (66%), or minimizing the problem (7%).

In another approach to coding these answers, based on a typology of barriers to environmental change developed by Gifford (2008), the most frequent replies were classified as a lack of perceived behavioral control (47%), claims that the respondent is already doing his or her part or even more (11%), uncertainty related to a lack of information (10%), that the government should act first (8%), denial that climate change is a problem (6%), habit (4%), other goals and priorities (3%), that industry should act first (3%), and a few others.

Responses to the second open-ended question, "I can do something about global warming *because...*" were coded to explore motivation and engagement factors. Forty-nine percent of responses could be described as "can-do," 17% were moralistic, citing pro-environmental actions as the right thing to do, 11% spoke of the need to protect children, the planet, or future generations, and 17% believed that every contribution helps, regardless of size. They also demonstrated a considerable sense of competence and engagement: 49% of the responses represented a "can-do" attitude, using phrases such as "I have the power," "I can," and "I know how." Seventeen percent used moral words, such as "ought," "duty," and "need to," and another 17% referred to the future or helping, with words such as "children," "grandchildren," "planet," and "every little bit helps."

4. Discussion

New messaging frames capable of moving climate change efforts toward greater effectiveness are needed, particularly because at the time this was written, public credence was sinking. These results demonstrate, for the first time to our knowledge, the value of what some observers have been calling for: messages that employ motivational-oriented and causative language rather than the sacrifice framing that has been employed by some climate change advocates and agencies.

This study did so in a large, representative community sample. Its specific goal was to investigate the influence of priming frame (motivational versus sacrifice) on perceived competence to act against climate change, climate change engagement, and behavioral intentions to act in mitigative ways. The two primary hypotheses, that exposure to motivational-oriented frames would be associated with greater reported competence and climate change engagement, compared to exposure to sacrifice-oriented frames, were confirmed. The hypothesis that priming would change behavioral intentions was confirmed for about half the behaviors. The hypothesis that demographic factors play an important role in the generalizability of these results was confirmed; the strongest of these is gender, but age and others also affected the results. Finally, the moral disengagement and barriers experienced by large segments of the population were described. These finding have important implications for the crafting of messages to whole populations as well as to distinct population segments.

4.1. Gender and age influences

Consistent with previous research, women reported greater perceived competence to engage with, and work against, climate change (Davidson and Freudenburg, 1996; Delhomme et al., 2009; Eisler et al., 2003; Hunter et al., 2004) and they expressed higher levels of environmental concern and guilt despite having less accurate knowledge about the causes and mechanisms of climate change (cf. Gifford et al., 1982–83). Older respondents generally reported greater intentions to act, yet felt less competent to act. These results clearly support the need for targeted messaging for different segments of the population.

4.2. The meaning for messaging

What do the results suggest for crafters of messages? If a communicator is unable to target specific population segments, for example, in a message from a government to all its citizens, then the results suggest that motivational messages clearly are to be preferred over sacrifice messages. However, if messages can be targeted, for example to media outlets that are primarily attended to by particular demographic groups, the results suggest that certain kinds of messages should be more effective than others.

For example, men appear to be more responsive to framing than women. Therefore, in media outlets mainly attended to by men, motivational messages clearly are to be preferred, and sacrifice messages clearly are to be avoided. Although women respond positively to motivational messages and negatively to sacrifice messages, these differences are far smaller than for men. However, given that women, like many citizens, sometimes are faced with defending their reasons for their concern and engagement, and

given that their level of factual climate knowledge is, on average, less than that of men, messages in media that are primarily attended to by women might do well to include more about the factual aspects of the problem. Otherwise, the danger might be: "You're concerned about climate change, but you don't know what you're talking about (so I am dismissing your views)."

At the same time, women are more concerned, engaged, and feel more competent than men about climate change. This suggests that if communication resources are limited, that communicators should tip the balance toward reaching men.

The communicator who is contemplating age-segmented media outlets is confronted with an odd paradox: perceived competence steadily declines with age, yet behavioral intentions increase with age, for about half of the behaviors examined. Thus, young people generally feel competent but are short on intention, whereas older people feel less competent but have stronger intentions. Apparently, then, messages placed in media frequented by younger people should include elements designed to enhance their intentions to engage in mitigative actions. Some of these behaviors may be less immediately possible for younger people if they less often own their residences or cars, but building their intentions at a relatively early age should set the stage for the time when they have their own residence (and thus have more control over choices in it) and vehicle (or even to choose not to own a car even when they are financially able to do so). As for older people, apparently messages in media outlets they attend to should emphasize that they are more capable of changing; for many behaviors, their intentions are already in place.

4.3. The role of semantics

The results also suggest that conceptual semantics might be used to develop new motivational-oriented pro-environmental frames. Conceptual semantics is "the language of thought distinct from language itself, "the inventory of concepts and schemas that combine them" (Pinker, 2007, p. 4). According to Pinker, the abstract language of thought is structured to distinguish space, time, force (causation), substance (possession), and intention (goals). When combined with motivational framing, the verb "shrink" generated, by far, the strongest perceived sense of competence among the six competence items. The verbs "break," "grow," and "move" were less powerful than "shrink," but generally more effective than "improve" and "feel able," which were least effective. Shrink and break, particularly, are causative verbs, directly linking cause and effect. A sentence like: "I can shrink my contribution to global warming" is agentic; it directly links the subject to the object, and potentially triggers moral thinking. Greater sensitivity to positive and motivational framing, including greater attention to the specific verbs utilized, would seem to make behavior change messages more effective.

4.4. Limitations

One obvious limitation of the present study, unavoidable in an online survey, is that it examined behavioral intentions rather than actual behavior. Self-presentation effects can lead participants to overstate their intentions to act pro-environmentally. Also, although the sample was a fully representative of a jurisdiction with 12 million people, its results nevertheless cannot be generalized with confidence beyond that jurisdiction.

4.5. Future directions

Effective frames for climate change solutions should enhance perceived competence and position climate change within a holistic sustainability ethic (Harris-Decima, 2008; Leiserowitz

and Fernandez, 2007). A useful next step would be to develop new frames based on these principles and to examine their effect. Frames designed for target particular segments, such as age and gender segments, should also be tested behaviors. Messages should be crafted for important societal segments, not only for age and gender, but also for those that differ in concern, knowledge, perceived competence, and mitigative behavior, so as to maximally engage the unengaged and to spur the engaged to do even more.

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