Economics, health, or environment: What motivates individual climate action?

Heidi E. Brown, Erika Austhof, Paula M. Luz, Daniel B. Ferguson

1 Department of Epi and Biostats, College of Public Health, University of Arizona, Tucson, AZ, United States of America, 2 Evandro Chagas National Institute of Infectious Diseases, Oswaldo Cruz Foundation, Rio de Janeiro, RJ, Brazil, 3 Department of Environmental Science, University of Arizona, Tucson, AZ, United States of America

* heidibrown@arizona.edu

Abstract

Climate change is a major threat to human health, however the role of health in climate change communication is understudied. The goal of this study was to understand how to support individuals' adoption of climate related mitigation and adaptation activities. We hypothesized the primary motivation for engaging in pro-environmental activities would be unequally distributed across health, economics, or environment motivations. We also hypothesized respondents who felt greater susceptibility and those with higher perceived self-efficacy would adopt more pro-environmental behaviors. In 2020, we conducted a cross-sectional study using Amazon’s MTurk platform. Among the respondents, the most commonly reported activity was alternatives to private vehicles (30% already engaging), while more than two thirds of respondents reported wanting to install solar panels (70.1%) and converting to a high efficiency vehicle (63.2%). Depending on the action, respondents' reported motivation varied. Economics was common to those who used public transportation and who installed solar paneling; purchasing a high efficiency vehicle was split between environment and economic reasons. Health was the primary motivation for converting to a plant-based diet. The perceived immediacy of climate change impacts was associated with adoption of pro-climate activities as were beliefs around human capacity to mitigate climate change. Despite the growing literature supporting health as a motivation for climate action, economic motivation was more commonly selected among the activities we evaluated. These results could aid the development of more efficient evidence-based communication strategies that would reach various audiences in society.

1. Introduction

Climate change may well be the greatest health threat of the 21st century [1]. Across 94 systematic reviews where the most studied outcomes were infectious disease, mortality and respiratory/cardiovascular or neurologic outcomes, there was consensus that climate change will result in worse human health [2]. The 2015 Lancet Countdown report found that the health impacts continue to worsen [1] and these negative health effects are projected to continue to...
increase with increasing global mean surface temperature [3]. Moreover the effects of climate change are disproportionate across populations intensifying health inequity globally [1, 4].

According to a September 2021 World Health Organization (WHO) Compendium, approximately 25% of deaths worldwide could be prevented through reductions of risk factors like air quality, climate change, unsafe infrastructure, and lack of safe water [5]. Of the 38 recommended actions to adapt or mitigate climate change cited in that document, actions for individuals or communities included lifestyle changes (e.g., diet, resource consumption, energy use, transportation), communication strategies (i.e., who and what to communicate about climate change), creation of functional landscapes, and increasing diversity in the foods grown and consumed. Identifying impacts and assessing vulnerabilities and actions is just the first step to building climate resilience.

While 92% of Americans were aware of global warming in 2006, the majority regarded it as a low national priority [6]. Closing the awareness-to-action gap has become the crux of climate change communication research since this publication [7]. Encouragingly, public awareness of and public opinion about actions one can take to mitigate and adapt to climate change reached an all-time high in 2020 [8]. One proposed theory for closing the awareness-to-action gap for climate change states that increasing personal awareness of the situation and of the associated risks, will motivate positive behaviors and changes [9]. The motivation to change can occur on a large scale, such as implementing larger industry changes, or on a personal level with individual actions.

Consumer behavior and lifestyle choices are some of the major drivers of climate change [10]. However, knowledge (facts and information) and awareness (perceptions and feeling) about the effects of climate change can vary by region and personal attributes [11, 12]. Being knowledgeable and aware does not directly lead to pro-environmental action [13, 14]. In an intervention study around climate action through a risk management framework, personal impact and human efficacy, protecting current and future generations were associated with motivation for action [15]. A 2019 meta-analysis, showed that while knowledge and experience were only weakly associated with adaptive behavior they were well studied and norms, perceived self-efficacy, and efficacy of action, though more predictive of adaptive behavior, were understudied [14].

Public health often frames health promotion through the Health Belief Model where motivation is explained through susceptibility, severity, benefits, barriers, and self-efficacy [16]. Rather than focusing on awareness and environmental identity, the social needs highlighted in the BUCKEt of Belonging, Understanding, Controlling, self-Enhancing and Trusting theoretical model may also provide better targets to motivate individuals for pro-environmental action [17]. Controlling of the BUCKEt model dovetails with self-efficacy of the Health Belief Model, suggesting that perceived control to act or control over one’s environment may support pro-environmental action. Related to control is an individual’s perceived susceptibility to climate change as something distant and uncertain and thus not controllable versus something ‘real,’ immediate and controllable [18]. In the Controlling motive, removing barriers and supporting perceived ability are important in promoting sustainable pro-environmental action.

Perceptions of risk, which can be framed as health risks, can be a strong motivation for behavioral change [19]. Awareness programs which include adverse impacts of climate change, we argue health impacts, with individual initiative can support climate change resilience [20]. Lifestyle changes like walking/biking rather than using a car or eating less meat also benefit health and wellness [21]. Sauerborn et al. [22] list three reasons to consider health effects in climate policy, namely 1) the impacts are large, growing, and not equitably distributed, 2) health can motivate behavior and policy changes, and 3) when quantified, the health co-benefits of mitigation activities will be significant. While a health effects framing can capture new
audiences and alternate views [23], health framing of climate change may narrow the discussion to only direct health impacts of climate change [24]. Still, framing climate change as a public health issue can motivate personal action and, when co-benefits are made explicit, increase support for mitigation policies [25–28]. In a study comparing among health effects, environmental, or national security framing of the benefits of mitigation and adaptation actions, news articles framed with a health lens were the most likely to elicit positive, supportive emotions [29]. Though still used less often than science, economic, or environmental frames [30], health has been effectively adopted as an effective frame for climate change communication [31].

Here we add to the literature on the role of previewed susceptibility and self-efficacy in adopting climate actions through report on an online survey conducted on a sample of US adults with a goal of understanding how to support individuals’ adoption of climate related mitigation and adaptation activities. We hypothesized that the primary motivation for individuals engaging in pro-environmental activities would not be equally distributed when asked to choose between health, economics, or environment. Next, we tested the hypotheses that respondents who perceived greater susceptibility and those with higher perceived self-efficacy would adopt more pro-environmental behaviors. Our goal is to aid in the development of more efficient evidence-based communication strategies to improve adoption of adaptation and mitigations actions.

2. Methods

2.1 Study instrument

The study instrument included 67 questions and was estimated to take 10–15 minutes to complete. In this manuscript, we use a subset of these 67 questions focusing on knowledge, intention, and motivations around climate change, climate-related behaviors individuals can adopt, as well as demographic questions (age, gender, race, ethnicity, neighborhood type, income, zip code, state). We formatted the survey flow to include attention check questions in each block as described in Smith et al. [32] to encourage data quality and completeness. Finally, the survey concluded with six questions adapted from a news article and a subsequent research article on ways to reduce personal carbon footprint in daily living as a way to assess knowledge of carbon-mitigating behaviors for individuals [33, 34]. The survey questions used are included as S1 Text.

2.2 Study population

The survey was distributed from July 14, 2020 to July 15, 2020 (n = 200) and from July 15 to August 14, 2020 (n = 300). Participants consented to participate in the survey and confirmed that they were at least 18 years of age and living in the US. Participants were paid $2 USD. Only MTurk masters (users with a strong track record for completion of prior tasks) were eligible to participate in the first 80% of total survey responses before it was opened to any MTurk user to assist with the enrollment target of 500 participants. Prior comparisons, including our own with these data, between masters and non-masters participants showed no significant demographic differences [35, 36].

MTurk is an on-demand crowdsourcing marketplace for remote workers to complete tasks. While some reviews indicate that MTurk is as reliable as other online survey platforms for convenience samples [37, 38], respondents are typically younger and more likely to have a college degree than national benchmarks [35]. Our MTurk respondents were younger, with higher education attainment, and lower income than other online crowdsourcing markets but with a similar distribution along a global warming audience segmentation tool [36].
2.3 Study variables

We focused on activities that individuals can choose to engage in on their own and grouped them into two general categories: mitigation activities (actions that can reduce or stabilize greenhouse gases [GHG]) and adaptation activities (actions to adapt to the changing climate). While some of these are both mitigation and adaptation activities, activities classified as mitigation included: converting to a plant-based diet, converting to a high efficiency car, installing solar paneling on residence, and traveling by public transport or biking rather than individual vehicle. Activities classified as adaptation included: harvesting water checking air quality before engaging in outdoor activities, wearing sun protection, reducing activity during the hottest part of the day, wearing mosquito and tick repellent when outdoors, and always bringing water on hikes and walks. For each of these activities, participants were asked to select whether they (a) already were doing, (b) wanted to in the next 6 months, (c) would in the future, or were (d) not interested. Then, only among those who indicated they already were doing the action, we queried their primary reason for engaging with the activity with response options (a) to save money, (b) to promote health, or (c) because of the environmental impacts. These options were selected because previous research has shown that framing climate change as a health issue motivates personal action [23, 29] but also that income is associated with individual environmental action [39]. Finally, to assess perceptions around need for adaptation activities (except water harvesting which was asked about primary reason to engage), we asked whether participants’ need for that activity had changed because of a changing climate.

2.4 Data analysis

Individuals reporting they converted to a plant-based diet, converted to a high efficiency car, installed solar paneling on residence, traveled by public transport or biking rather than individual vehicle, or harvested water were asked to select a primary reason for doing so from economic, health, or environmental reasons. Chi square goodness of fit test was used to compare an even distribution to the observed distribution of motivations (i.e., economic, health, or environmental). Those reporting that they checked air quality before engaging in outdoor activities, wore sun protection, reduced activity during the hottest part of the day, wore mosquito and tick repellent when outdoors, and always brought water on hikes and walks were asked to assess whether the need had increased, stayed the same or decreased because of a changing climate. Chi square goodness of fit test was used to compare an even distribution to the reported change in need for action (i.e., increased, stayed the same, decreased, or not related to a changing climate).

Additionally, to explore individual’s behaviors across all individual actions, for each of the activities we assigned a value for whether individuals were doing (4), would do in the next six months (3), wanted to do in the future (2) or didn’t want to do (1). A “doing score” was then calculated as the average score for all individual activities with high scores indicating those engaging in more actions and low scores indicating less action or interest in engaging in action. Based on others finding an association between personal experience and climate change [40], we hypothesized that higher doing score would be associated with greater immediacy with respect to climate change effect. Accordingly, the “doing score” was compared across groups based on individuals’ perceptions of when climate change will start to harm people in the United States ((a) now, (b) in 10 to 25 years or (c) 50–100 years or (d) Never) and whether humankind can stop it ((a) isn’t happening, (b) can’t reduce even if it is happening, (c) could reduce but aren’t willing, (d) could reduce but unclear if will, or (e) can and will), using ANOVA adjusting for multiple comparison using Tukey’s method and controlling for the MTurk covariates. Given prior research describing how MTurk samples systematically
differ from US probabilistic samples, we controlled for age, gender, race and ethnicity, income and education [41].

A graphical depiction of the analysis is provided as S1 Fig. All analyses were completed using Stata v 15 (StataCorp, College Station, Texas). Data are available as S1 Data.

2.5 Ethics approval and consent to participate

The University of Arizona Institutional Review Board reviewed this research (Protocol # 2001327261A001) and deemed it exempt for limited review under 45 CFR 46.109(a).

3. Results

Of the 508 participants who completed the survey, four respondents were excluded due to failure to answer the attention check questions for a total of 504 responses, with a median completion time of 12.7 minutes. Similar to US demographics, participants’ gender was evenly split between males (49.6% compared to 49.2% US) and females (49.4% compared with 50.8% reported for the US; Table 1). Five individuals reported their gender as non-binary (n = 4, 0.8%) or self-described (n = 1, 0.2%). Respondents were primarily white (77.5% compared with 76.3% nationally). Most (69.0%) reported an associate or bachelor’s degree or more. While 25% of respondents indicated affiliation with the republican party, similar to US national estimates, democratic party affiliation was most commonly selected among our respondents (47.8%) while independent party affiliation most common among national estimates (40%). Questionnaires were completed by individuals from 46 states and Washington, DC. Using the National Climate Assessment categorizations of states, most participants were from the Southeast (27.2%), Northeast (22.4%), Midwest (19.3%) and Southwest (18.7%). No individuals from Alaska, 3 individuals from Hawaii, and only 5 from the Northern Great Plains completed the questionnaire.

3.1 What people are doing?

Among the mitigation activities, the most commonly reported activity was using public transportation or biking, with 30% of respondents marking this as an activity they already engage in. Installing solar panels and converting to a high efficiency vehicle were the most common actions that individuals would like to do but were not yet doing (70.1% and 63.2% of respondents, respectively). While converting to a plant-based diet was not a commonly selected action (55.9% were not interested), it was the second most frequent activity that individuals reported adopting if they were interested (27% of those interested were already doing). Using public transportation was the most commonly adopted activity where 51.5% of those interested were already using public transportation. See Fig 1.

With respect to health actions for individuals to adapt to climate change, reducing activity during the hottest times of the day, using sun protection and bringing water on walks and hikes were the most commonly reported activities (78.2%, 75.0%, and 74.2%, respectively). These percentages jump to near 80% when considering only those with an interest in the action (84.0%, 81.3%, and 79.0%, respectively).

The reported motivation for those reporting doing an action was not evenly distributed across the three options: environment, health, or economic. Among individuals who reported already doing the mitigation activities described above, economics was provided by over 50% of participants as the reason among those using public transport or biking rather than an individual vehicle and by those who installed solar paneling on their residence (Table 2). The impact on the environment was a primary reason among those who were water harvesting. Interestingly, the primary reason given for converting to a high efficiency car was about evenly
Motivations for climate action

split between environmental impact and economic reasons. Health was the most reported motivation only for converting to a plant-based diet.

Among adaptation activities, a need driven by climate change for checking air quality, using sun protection, and reducing activity when it is hot was reported (Table 3). While no change was reported for the need to bring water on hikes or to use insect repellent.

### 3.2 Are perceptions associated with action

We compared the overall “doing” score with respondents’ beliefs about when climate change will start to harm people in the United States (Fig 2) and their views about whether climate change can be mitigated (Fig 3). Bartlett’s test for equal variances indicated the ANOVA was not valid with 6 categories of when impacts will be observed, so responses were combined into three categories (Fig 2). Controlling for the MTurk sampling bias, respondents who report

---

**Table 1. Summary of demographic information of those completing the online survey, July 14-August 14, 2020, N = 500.**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>n (%)</th>
<th>National Comparison a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD); range</td>
<td>41.6 (11.3); Range 24–76</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>250 (49.6%)</td>
<td>49.2%</td>
</tr>
<tr>
<td>Female</td>
<td>249 (49.4%)</td>
<td>50.8%</td>
</tr>
<tr>
<td>Non-Binary</td>
<td>4 (0.8%)</td>
<td></td>
</tr>
<tr>
<td>Self-Describe</td>
<td>1 (0.2%)</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White and other</td>
<td>405 (80.4%)</td>
<td></td>
</tr>
<tr>
<td>White alone</td>
<td>390 (77.5%)</td>
<td>76.3%</td>
</tr>
<tr>
<td>API and other</td>
<td>43 (8.5%)</td>
<td></td>
</tr>
<tr>
<td>Black and other</td>
<td>42 (8.3%)</td>
<td></td>
</tr>
<tr>
<td>Black alone</td>
<td>36 (7.2%)</td>
<td>13.4%</td>
</tr>
<tr>
<td>API alone</td>
<td>34 (6.8%)</td>
<td>6.1%</td>
</tr>
<tr>
<td>Hispanic &amp; other</td>
<td>27 (5.4%)</td>
<td>18.5%</td>
</tr>
<tr>
<td>AIAN and other</td>
<td>3 (0.6%)</td>
<td></td>
</tr>
<tr>
<td>Total Household Income (in 1000s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;$30</td>
<td>114 (22.6%)</td>
<td>~ 22.2%</td>
</tr>
<tr>
<td>$30–99</td>
<td>314 (62.3%)</td>
<td>~ 44.4</td>
</tr>
<tr>
<td>≥$100</td>
<td>76 (15.1%)</td>
<td>33.6%</td>
</tr>
<tr>
<td>Education Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some College or Less</td>
<td>156 (31.0%)</td>
<td>88%</td>
</tr>
<tr>
<td>Associate/Bachelor or more</td>
<td>348 (69.0%)</td>
<td>32.1%</td>
</tr>
<tr>
<td>Party Affiliation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Democrat</td>
<td>241 (47.8%)</td>
<td>31%</td>
</tr>
<tr>
<td>Independent</td>
<td>126 (25.0%)</td>
<td>40%</td>
</tr>
<tr>
<td>Republican</td>
<td>124 (24.6%)</td>
<td>25%</td>
</tr>
<tr>
<td>No preference</td>
<td>7 (1.4%)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>6 (1.2%)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: SD, standard deviation

a Household income estimated from Statistica (note that percentage 25-35K was divided by 2 for estimate) [42] and Gallup News’ Historical trends for party affiliation, [43] and for all other, the US Census population estimates for 2019 [44]
climate change is happening now or in their lifetime (10-25yrs), scored higher with respect to engagement with adaptation and mitigation activities than those who believe it will never happen or will happen to the next generation (F(59,443) = 1.45, p = 0.02, \( \eta^2 = 0.162 \)).

Compared to people who think we cannot reduce global warming, those who believe that climate change can be addressed reported engaging in more activities (F(61,441) = 1.42, p = 0.03, \( \eta^2 = 0.164 \)) after controlling for MTurk sampling bias. Specifically, compared to those who believed humans cannot reduce global warming, more activities were engaged in by those who believe humans could reduce global warming but are not willing (Tukey’s t = 4.54, \( p < 0.001 \)), those who believe humans could but it is unclear if they will (Tukey’s t = 5.20, \( p < 0.001 \)), and those who believe humans can and will do so successfully (Tukey’s t = 2.86, \( p < 0.035 \)).

4. Discussion

Using an online sample of US respondents, we sought to assess pro-environmental behaviors individuals can engage in and their motivations around those behaviors they adopt. We hypothesized that the primary motivation for individuals engaging in pro-environmental actions reported their motivation.

Table 2. Motivations for engaging in activities.

<table>
<thead>
<tr>
<th>Environmental</th>
<th>Health</th>
<th>Economic</th>
<th>( X^2 )</th>
<th>Cramer’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant-based Diet</td>
<td>18 (30.0%)</td>
<td>40 (66.7%)</td>
<td>2 (3.3%)</td>
<td>36.4</td>
</tr>
<tr>
<td>High Efficiency Vehicle</td>
<td>28 (48.3%)</td>
<td>1 (1.7%)</td>
<td>29 (50%)</td>
<td>26.1</td>
</tr>
<tr>
<td>Solar Panel</td>
<td>11 (37.9%)</td>
<td>3 (10.3%)</td>
<td>15 (51.7%)</td>
<td>7.72</td>
</tr>
<tr>
<td>Public Transport/Bike</td>
<td>34 (22%)</td>
<td>42 (27%)</td>
<td>76 (50%)</td>
<td>19.63</td>
</tr>
<tr>
<td>Water Harvesting</td>
<td>26 (49%)</td>
<td>8 (15%)</td>
<td>19 (36%)</td>
<td>9.32</td>
</tr>
</tbody>
</table>

Chi Sq GOF compared to even distribution across response options. Bolded values indicate statistically significant values at \( p < 0.05 \). Only those engaging in pro-climate actions reported their motivation.
activities would be unequally distributed when asked to choose between health, economics, or environment. Further, we hypothesized that respondents who had greater perceptions of susceptibility to global warming and those who felt greater self-efficacy, measured as belief in global ability to act to control global warming, would be supportive of those individuals engaging or intending to engage in action. We found that travelling by public transport or biking rather than individual vehicles and converting to a plant-based diet were the most common activities individuals were already engaged with. We found support for our hypothesis that the motivations provided would not be evenly distributed across environment, health, and economics. Economics then health was the primary reason selected for adopting these behaviors. Furthermore, we found support for the hypothesis that higher perceived susceptibility, measured as recognition that climate change is happening now or that it will happen in their lifetime, was associated with higher scores for doing or wanting to do adaptation and mitigation activities. Finally, we found support for our hypothesis that perceived efficacy, global action to reduce climate change effects, was associated with engaging or wanting to engage in more activities compared with those who do not think global warming can be reduced.

A limitation to our survey is that it is a cross-sectional study using an online convenience sample. We did not collect robust open-ended questions to dive deeper into the motivations, rather we allowed participants to select between three prescribed options. The respondents in this cross-sectional convenience sample study are slightly younger and more educated than national samples [35, 36]. While we adjusted for this sampling bias when comparing action with perceived susceptibility and self-efficacy, the results should be interpreted with this in mind.

Table 3. Perceptions around the need for climate related health actions.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Increased</th>
<th>Same</th>
<th>Decreased</th>
<th>N/A</th>
<th>X²</th>
<th>Cramer’s V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bring Water</td>
<td>131 (35%)</td>
<td>207 (55.5%)</td>
<td>0</td>
<td>35 (9.4%)</td>
<td>119.5</td>
<td>0.327</td>
</tr>
<tr>
<td>Check Air Quality</td>
<td>120 (63.8%)</td>
<td>57 (30.3%)</td>
<td>3 (1.6%)</td>
<td>8 (4.3%)</td>
<td>189.1</td>
<td>0.580</td>
</tr>
<tr>
<td>Use Sun Protection</td>
<td>202 (53.6%)</td>
<td>147 (39.0%)</td>
<td>0</td>
<td>28 (7.4%)</td>
<td>125.9</td>
<td>0.334</td>
</tr>
<tr>
<td>Reduce Activity</td>
<td>223 (56.6%)</td>
<td>138 (35.0%)</td>
<td>11 (2.8%)</td>
<td>22 (5.6%)</td>
<td>310.4</td>
<td>0.512</td>
</tr>
<tr>
<td>Insect Repellent</td>
<td>96 (31.9%)</td>
<td>164 (54.5%)</td>
<td>2 (0.7%)</td>
<td>39 (13.0%)</td>
<td>199.2</td>
<td>0.470</td>
</tr>
</tbody>
</table>

Chi Sq GOF compared to even distribution across response options. Bolded values indicate statistically significant values at p<0.05. Only those engaging in pro-climate actions reported their perception of changes in need.

![Fig 2. Association between activities engaged in and responses to the question "When do you think global warming will start to harm people in the United States." Points represent outliers.](https://doi.org/10.1371/journal.pclm.0000177.g002)
We restricted this analysis to actions that individuals can engage in. While recycling and changing to more efficient household light bulbs are commonly promoted as actions individuals can take, they have lower marginal effects, while being easier to modify through intervention [45]. In contrast, living car-free (2.4 tons of carbon dioxide equivalent (tCO2e) saved per year), avoiding air travel (1.6 tCO2e saved per roundtrip transatlantic flight) and eating a plant-based diet (0.8 tCO2e saved per year) are individual activities with a potential to substantially reduce annual personal emissions [46]. While we did not ask about air travel, of the two other high impact individual activities, only 11.9% of individuals in our survey had converted to a plant-based diet with a further 55.9% reporting they were not interested in doing so and only 11.5% reported driving a high efficiency car, though 63.2% were interested in doing so in the future.

4.1 Economic and health motivations for mitigation

The most common mitigation activity respondents engaged in was traveling by public transportation or biking rather than an individual vehicle (30%), and economics was the overwhelmingly most common motivation (50%), with the rest of responses split evenly between response options of environment and health. The question did not distinguish between whether the individual used public transport or biked. Surveys show more urban (21%) US adults regularly use public transport, compared to suburban (6%) or rural (3%) [47]. Insufficient service is cited for lower rates of public transportation use, and intercity coverage in rural areas is declining [48]. It is interesting that in our study economics was the most important motivation for adoption of public transportation/biking, as financial incentives have also been used as a motivation to encourage public transportation use with some success [49].

Moving towards a plant-based diet could reduce global mortality by 6–10% and reduce food-related GHG by 29–70% [50]. Even the lowest impact animal husbandry exceeds the impact of vegetable substitutes [51]. Among those individuals who had converted to a plant-based diet (n = 60 of 504 respondents), health was the most commonly reported reason (66.7%). Framing this activity with a health lens may promote engagement in converting fully to a plant-based diet or increasing the proportion of plants in a person’s diet. While the mechanism may not be clearly delineated, there is evidence that a diet rich in plants reduces atherosclerosis and coronary artery disease [52], obesity [53], type-2 diabetes [54], and lower all-cause mortality [55]. Our finding of about 12% who had converted and 50% not contemplating is similar to an Australian study with more individuals engaged (28%) but a similar percentage not (58% in precontemplation) [56].
Like ours, health was listed as a reason to convert to a plant-based diet as was finances, but they also found convenience and knowledge were listed as barriers. Çoker and van der Linden found that attitude, norms and perceived control explained more than half of the variation in intention to reduce meat consumption [57]. While moving towards a more plant-based diet is a personal choice that not everyone may be able—or will want—to do, our results suggest that, instead of focusing on the impact on climate, framing this choice as a health-related decision may be the best motivating factor for encouraging individuals to take this action. Furthermore, as knowledge is a cited barrier to adopting plant-based diets, educational campaigns focusing on the health-related advantages of diet should be promoted.

In our survey, almost 70% wanted to install solar panels in the future and 63.2% wanted to convert to a high efficiency car, while only 5.8% and 11.5% had successfully done so. According to the US EPA, approximately 29% of US GHG emissions are from the transportation industry [58], and the use of solar panels can induce regional cooling (by 2°C) [59]. Our results suggest that, if the right incentives were put in place, significant mitigation effects could be produced [58]. In the US, it will be interesting to assess the impact of the Biden Administration’s recently signed Inflation Reduction Act, which, among other actions, includes tax incentives for electric vehicles. A high efficiency car, for example, is between $500-$10,000 more expensive than comparable conventional cars and due to the battery cost, may be unaffordable to many [60]. While this upfront cost is higher compared to conventional cars, the cost to run them is estimated to be lower [61].

Additionally, we found that among those who successfully engaged, the choice around high efficiency vehicles was split almost evenly between selecting the environmental (48.3%) and economic (50%) motivation options while the selected motivations around solar was slightly more economic (51.7%) than environmental (37.9%). A ZIP code level analysis of residential solar installation in the US found that economic factors were significant indicators of installation, among other factors [62]. However, despite rebates, credits and other incentives to support installation of solar panels cost remained a significant barrier to installation in the UK [63]. That over two-thirds of our respondents wanted to engage in these activities suggests the need for alternative and/or improved strategies to support adoption.

4.2 Supporting individual engagement

While our summary of the findings up to this point has focused on individual actions, individual actions alone cannot mitigate climate change. Lessons learned from implemented renewable energy policies reinforce the need for a clearly articulated rationale, cost containment strategies, and an assortment of policies to promote individual engagement in these activities with higher upfront costs [64, 65]. However, the necessary changes are not just in policies, but also as changes to social and cultural norms [18]. This change in norms is somewhat evident in the high adoption of the health adaptation behaviors that individuals can engage in in our study. For most of these activities, most of the respondents were already doing them (78% reduce activity during the hottest part of day; 75% use sun protection, 74% bring water on walks and hikes, 60% use insect repellent). These health-conscious behaviors have become norms. Only through encompassing, trans-sectoral change with policies that support individuals and remove barriers can the necessary cultural and lifestyle changes occur [9].

In addition to the finding that those with positive beliefs (humans can and will stop climate change) were engaging in climate-smart actions, we found that those who believed that humans could but are not willing or that humans could but will not do what is needed reported doing more of the activities we asked. This has been seen by others as well. Eco-anger—anger experienced in response to the climate crisis—was associated with greater engagement
in personal pro-climate behaviors among Australians in 2020 [66]. A nationally representative
survey in the US also found that worry, interest, and hope were discrete emotions strongly
associated with increased support for climate change policies [67]. Shifting the conversation
toward control and self-efficacy [68], climate change communication that focuses on the gains
with action rather than losses with no-action is associated with increased positive attitude
toward climate change mitigation [69, 70]. Further, messaging the protective actions rather
than risks, may be most important among vulnerable populations who already are more likely
to identify themselves at higher risk for climate change impacts [71]. Related, our finding that
those who perceive climate change as happening now or in their lifetime engage in more
action supports the recommendation to emphasise that climate change is present, local and
personal [72].

There is no consensus on how to best support individual choice to engage in climate action.
A comprehensive approach that includes both mitigation and adaptation actions is critical
[73]. In a metaanalysis of behavioral intervention to promote individual engagement in climate
mitigation actions found behavioral interventions alone were insufficient to yield long term
change, but might be useful in combination with other strategies [45]. When considering how
to nudge individuals towards pro-climate behaviors, be it for themselves or for the environ-
ment, behavioral economics, a field which focuses on understanding individual decision mak-
ing, has suggested that both the framing and the emotional content of the messages can be
important [74]. Framing climate change within a public health focus has been suggested as a
means to engage policy makers, namely to account for the co-benefits of GHG emission reduc-
tions [75]. However, reported motivations are not necessarily indicative of the true motivation
for engagement. Noppers et al. [76] found instrumental values (e.g. the highly cited economic
motivation in our study) were less important than symbolic or environmental reasons for
adoption, though the significance of instrumental values are overestimated. Related, a public
health framing rather than a national security framing has been shown to elicit more support
toward mitigation and adaptation actions [29] and specifically, those with content that is less
familiar (food-, water-, and vector-borne diseases) were most engaging [28]. Likely no one
framing will be sufficient to instill long term behavioral change, but more work is necessary to
establish the effects of interventions both in isolation and in combination [45].

5. Conclusion
In conclusion, our results show that the uptake of individual adaptive behaviors is already
high, which aligns with and may result from the growing public awareness of actions one can
take to mitigate and adapt to climate change [8]. The actions we included as adaption, though,
have low barriers, being relatively inexpensive and easy. In contrast, the actions we included as
mitigation actions are more cost prohibitive and harder to engage. We went beyond beliefs
around climate change and asked about the motivations of those reporting engaging in pro-cli-
mate actions and found that health was the motivation listed only for converting to a plant-
based diet. Great interest in high-efficiency vehicles and solar panels was reported and eco-
nomics was the primary reason for those who had adopted these activities. Importantly, we
found that those who did not believe climate change could be addressed were less likely to
engage in activities. These results could aid the development of more efficient evidence-based
communication strategies that would reach various audiences in society.

Supporting information
S1 Text. Survey questions. The questions used in the survey.

(DOCX)
S1 Fig. Study methodology.
(TIF)

S1 Data. Participant responses. Participant responses to questions used in the survey.
(XLSX)

Author Contributions
Conceptualization: Heidi E. Brown.
Data curation: Erika Austhof.
Formal analysis: Heidi E. Brown, Paula M. Luz.
Funding acquisition: Daniel B. Ferguson.
Project administration: Heidi E. Brown, Erika Austhof.
Supervision: Heidi E. Brown.
Visualization: Heidi E. Brown.
Writing – original draft: Heidi E. Brown, Erika Austhof, Paula M. Luz.
Writing – review & editing: Heidi E. Brown, Erika Austhof, Paula M. Luz, Daniel B. Ferguson.

References


