

Local Warming: Daily Temperature Changes Influence Belief in Global Warming

Supplementary Materials

Respondents and Procedure

Participants in Studies 1a and 1b volunteered for a “quick 3-minute survey” via a website link. We recruited participants from the United States and Australia, respectively, for Studies 1a and 1b. Participants were about evenly split on gender (49% male in the U.S. and 51% male in Australia) with a modal and median age in the 55-64 range. U.S. participants reported a higher level of education (88% had completed at least some college) than Australian participants (62%). In the U.S., participants reported themselves as Democrats (24.8%), Republicans (30.5%), or other (44.8%). In Australia, participants reported themselves as supporters of the Labor Party (center-left; 27.2%), Liberal or National Party (center-right; 32.6%), Greens (left; 25.5%), or other (14.7%). Participants in Study 2 completed a 25-minute study after receiving an invitation via Columbia University’s Center for Decision Sciences Virtual-Lab database. Participants were about evenly split on gender (46% male) with a mean age of 39 ($Med = 33.6$, $SD = 15.4$) and a high level of education (75% had completed at least some college). When asked to self-identify, participants reported themselves as Democrats (43.8%), Republicans (16.9%), or other (39.4%).

All participants reported their belief in (“How convinced are you that global warming is happening?”) and concern about global warming (“How much do you personally worry about global warming?”). These global warming questions were always asked in this order, but were counterbalanced with a question about perceived deviation from the usual temperature (“Is the temperature in your city colder or warmer than usual today for this time of year?”).

Analysis

Studies 1a and 1b

To assess potential effects of question order and country, we ran regressions on belief in and concern about global warming analyzing the effects of question order (global warming questions first), country (participant in the U.S.) and perceived deviation from usual temperature (in the warmer direction), along with all interaction terms.¹ Because both dependent variables are ordinal with only four scale values, we used ordered logistic regressions. Results with ordinary linear regressions are similar. The regression on belief showed a linear effect of perceived deviation ($\beta = .41, z = 5.64, p < .0001$) and that the US had lower belief ($\beta = -.16, z = 1.85, p = .06$). In addition, there was an interaction effect between perceived deviation and country ($\beta = .31, z = 2.15, p < .05$), meaning that the effect of perceived deviation on belief was slightly stronger in the U.S. The regression on concern showed a linear effect of perceived deviation ($\beta = .23, z = 6.69, p < .0001$) and that the US had lower concern ($\beta = -.30, z = 2.11, p < .05$). In addition, there was an interaction effect between question order and country ($\beta = .56, z = 1.94, p = .05$), meaning that the between-country difference in concern was somewhat reversed when the global warming question came first. We did not predict either interaction effect and will not speculate on their interpretation. More important, we find little evidence for an effect of question order on the effect of perceived deviation on either belief ($\beta = .22, z = 1.53, p = .12$) or concern ($\beta = .24, z = 1.55, p = .12$).

We used participants' ZIP codes to gather publicly available data from weather.com (Studies 1a and 2) and weatherzone.com.au (Study 1b) to get objective measures of the actual daily high and low temperatures and the historical average high and low temperatures.² We calculated average temperatures by taking the midpoints of these ranges. We then calculated

¹ All independent variables were centered.

² Note that the Australian weather data does not include daily high and low temperatures but instead uses monthly high and low temperatures. This may cause additional noise in objective deviations from the historical average.

objective deviations from historical average temperatures by taking the simple difference between that day's average and the historical average. U.S. temperatures during Study 1a averaged 1.3 degrees Celsius ($sd = 7.0$) with a mean deviation of -2.6 degrees ($sd = 3.6$), whereas Australian temperatures during Study 1b averaged 23.5 degrees ($sd = 3.1$) with a mean deviation of 1.1 degrees ($sd = 2.8$). Both studies were conducted in February of 2010.

Table 1 lists the regression results for six regressions on belief in global warming in Study 1a controlling for incrementally more variables. Note that we show results for linear regressions for ease of interpretation, but ordered logistic regressions give similar, if not stronger, results. Results for concern about global warming are similar. Women and Democrats (relative to Independents) reported more belief in global warming, whereas older participants and Republicans reported less. There was again no effect of question order. Most important, the effect of perceived deviation from usual temperature persists even after controlling for all other variables, including actual temperature and actual deviation from the historical average.³ Table 2 lists the equivalent set of regression results for Study 1b with very similar results.

³ We also controlled for the one year ago deviation from the historical average and find no difference.

Table 1. Linear regressions for belief in global warming in Study 1a.

Model	1	2	3	4	5	6
Perceived deviation	0.308*** (0.267)	0.281*** (0.244)	0.217*** (0.185)	0.191*** (0.163)	0.277*** (0.241)	0.190*** (0.163)
Actual temperature		0.00292 (0.0327)		0.00142 (0.0161)	0.00395 (0.0443)	0.00235 (0.0266)
Actual deviation		0.00857 (0.0500)		0.00796 (0.0459)	0.00822 (0.0480)	0.00778 (0.0449)
Female			0.168** (0.0745)	0.175** (0.0774)		0.179** (0.0795)
Age			-0.093*** (-0.0992)	-0.096*** (-0.102)		-0.096*** (-0.102)
Education			0.0340 (0.0463)	0.0320 (0.0436)		0.0316 (0.0430)
Democrat (relative to Other)			0.970*** (0.372)	0.966*** (0.371)		0.960*** (0.368)
Republican (relative to Other)			-0.485*** (-0.198)	-0.479*** (-0.196)		-0.461*** (-0.189)
Order: Global warming questions first					-0.138 (-0.0612)	-0.0399 (-0.0177)
Order x Perceived deviation					0.157 (0.0681)	0.0288 (0.0123)
Order x Actual temperature					0.00885 (0.144)	0.00632 (0.103)
Order x Actual deviation					-0.000925 (-0.00332)	0.00451 (0.0163)
Constant	1.545*** (1.375)	1.465*** (1.302)	1.704*** (1.512)	1.699*** (1.508)	1.426*** (1.268)	1.660*** (1.474)
Observations	582	578	525	525	578	525
R ²	0.071	0.076	0.332	0.335	0.088	0.341

Note: Standardized regression coefficients in parentheses. Perceived deviation, actual deviation and temperature, and order are centered. Sample size is smaller for some regressions due to incomplete responses. * < .10, ** < .05, *** < .01.

Table 2. Linear regressions for belief in global warming in Study 1b.

Model	1	2	3	4	5	6
Perceived deviation	0.139** (0.125)	0.135** (0.120)	0.172** (0.155)	0.164** (0.147)	0.138** (0.123)	0.164** (0.148)
Actual temperature		-0.0154 (-0.0895)		-0.0149 (-0.0885)	-0.0149 (-0.0865)	-0.0139 (-0.0827)
Actual deviation		0.00864 (0.0444)		0.0122 (0.0627)	0.00822 (0.0422)	0.0117 (0.0603)
Female			0.289** (0.146)	0.303** (0.155)		0.299** (0.153)
Age			-0.0856* (-0.112)	-0.0844* (-0.110)		-0.0876* (-0.114)
Education			0.0295 (0.0487)	0.0424 (0.0695)		0.0456 (0.0749)
Labor (relative to Other)			0.207 (0.0911)	0.238 (0.105)		0.200 (0.0886)
Liberal/National (relative to Other)			-0.605*** (-0.281)	-0.560*** (-0.264)		-0.580*** (-0.273)
Green (relative to Other)			0.0779 (0.0335)	0.0760 (0.0326)		0.0514 (0.0220)
Order: Global warming questions first					3.033 (1.553)	1.920 (0.980)
Order x Perceived deviation					0.0721 (0.0322)	-0.0166 (-0.00747)
Order x Actual temperature					-0.0414 (-1.578)	-0.0260 (-0.982)
Order x Actual deviation					0.0483 (0.134)	0.0400 (0.108)
Constant	1.630*** (1.656)	2.755** (2.815)	2.011*** (2.035)	3.013*** (3.071)	2.719** (2.779)	2.973*** (3.030)
Observations	290	279	243	232	279	232
R ²	0.016	0.017	0.193	0.193	0.027	0.200

Note: Standardized regression coefficients in parentheses. Perceived deviation, actual deviation and temperature, and order are centered. Sample size is smaller for some regressions due to incomplete responses. * < .10, ** < .05, *** < .01.

Study 2

In Study 2, we collected a number of additional variables in order to rule out potential alternative explanations of the effect. These included income, the weather conditions (cloudiness, wind, rain, snow), and region of the country.

Tables 3A-C list the regression results for regressions on beliefs, concern and donations in Study 2 controlling for incrementally more variables. As in Studies 1 and 2, women and Democrats reported more and Republicans reported less belief in global warming. Richer participants also reported more belief. Richer participants and Democrats reported more concern about global warming as well. However, this higher belief and concern did not translate into higher donations. Table 3C shows only a marginal positive effect of education on donations in addition to the effect of perceived deviation.

Although income, education, and political affiliation should account for most demographic differences in the United States, we tested for regional differences in beliefs that may not be captured by other individual differences. Adding indicator variables for the four official census regions (Northeast, South, Midwest, and West) of the United States to the most comprehensive regressions (model 4) in Table 3 did not return significant results for any of the three indicator variables. Similarly, adding dummy variables for the nine official census divisions (New England, Middle Atlantic, South Atlantic, East North Central, East South Central, West North Central, West South Central, Mountain, and Pacific) returned no systematic effects.

We additionally controlled for the actual weather (aside from temperature) by coding the weather conditions for each ZIP code on the day the study was completed. The only significant finding was that rainy days resulted in both more belief in ($\beta = .44$, $t(249) = 2.19$, $p < .05$) and

concern about ($\beta = .46, t(249) = 2.19, p < .05$) global warming, but not higher donations ($\beta = .21, t(249) = .46, ns$).

We also examined if our effects might be restricted to those with stronger environmental concerns. Participants answered two questions adapted from the revised New Environmental or Ecological Paradigm (NEPr) scale (Dunlap, Liere, Mertig, & Jones, 2000). Unsurprisingly, general concern for the environment increased belief ($\beta = .21, t(249) = 7.19, p < .0001$), concern ($\beta = .23, t(249) = 7.39, p < .0001$), and donations ($\beta = .29, t(249) = 3.95, p < .001$). Linear regressions on perceived deviation from usual temperature, general environmental concern, and their interaction showed that general environmental concern does not eliminate the effect of perceived deviation (β s = .13, .24, and .22; $t(247) = 2.67, 4.76, \text{ and } 1.76; p < .01, .0001, \text{ and } .10$, respectively) but does attenuate its effect on belief ($\beta = -.12, t(247) = 4.62, p < .0001$) and concern ($\beta = -.05, t(247) = 2.00, p < .05$). That is, participants with stronger environmental attitudes were less likely to be influenced by irrelevant daily temperature fluctuations.

Finally, we asked respondents directly if they thought the global warming and temperature questions were related. The majority of participants indicated the two questions were probably (50%) or definitely (22%) related, although nobody guessed the purpose of the study in an open-ended debriefing question. Participants who thought the questions were related were more likely to believe in ($\beta = .13, p < .05$) and be concerned about ($\beta = .26, p < .001$) global warming, but the relationship between perceived deviation and belief ($\beta = .14, p < .05$) and concern ($\beta = .25, p < .001$) about global warming remained significant. The interactions were not significant (β s = .07 and .02, *ns*), meaning that the effect of perceived deviation on belief and concern was the same for people who did and did not think the global warming and temperature questions were related.

Table 3A. Linear regressions for belief in global warming in Study 2.

Model	1	2	3	4
Perceived deviation	0.145*** (0.167)	0.152** (0.176)	0.150** (0.177)	0.179*** (0.212)
Actual temperature		0.00573 (0.0690)		0.00695 (0.0841)
Actual deviation		-0.00619 (-0.0419)		-0.0151 (-0.0998)
Female			0.278** (0.152)	0.268** (0.147)
Education			0.00474 (0.0788)	0.00499 (0.0829)
Age			-0.0145 (-0.0267)	-0.0163 (-0.0299)
Income (thousands)			0.0031*** (0.227)	0.0029*** (0.213)
Democrat (relative to Other)			0.363*** (0.197)	0.372*** (0.202)
Republican (relative to Other)			-0.341** (-0.139)	-0.348** (-0.142)
Constant	2.024*** (2.188)	2.024*** (2.188)	1.414*** (1.543)	1.430*** (1.561)
Observations	251	251	223	223
R ²	0.028	0.033	0.160	0.172

Note: Standardized regression coefficients in parentheses. Sample size is smaller for some regressions due to incomplete responses. * < .10, ** < .05, *** < .01.

Table 3B. Linear regressions for concern about global warming in Study 2.

Model	1	2	3	4
Perceived deviation	0.262*** (0.290)	0.286*** (0.316)	0.193*** (0.218)	0.226*** (0.254)
Actual temperature		-0.00128 (-0.0147)		-0.00204 (-0.0235)
Actual deviation		-0.00875 (-0.0565)		-0.0142 (-0.0891)
Female			0.174 (0.0905)	0.171 (0.0887)
Education			0.00166 (0.0262)	0.00251 (0.0396)
Age			-0.0208 (-0.0364)	-0.0177 (-0.0310)
Income (thousands)			0.0044*** (0.306)	0.0045*** (0.314)
Democrat (relative to Other)			0.416*** (0.215)	0.405*** (0.209)
Republican (relative to Other)			0.0105 (0.00408)	-0.00685 (-0.00265)
Constant	1.622*** (1.672)	1.622*** (1.672)	1.035*** (1.074)	0.988*** (1.025)
Observations	251	251	223	223
R ²	0.084	0.087	0.204	0.212

Note: Standardized regression coefficients in parentheses. Sample size is smaller for some regressions due to incomplete responses. * < .10, ** < .05, *** < .01.

Table 3C. Linear regressions for donation to Clean Air-Clean Planet in Study 2.

Model	1	2	3	4
Perceived deviation	0.249** (0.126)	0.296** (0.149)	0.231 (0.113)	0.305* (0.149)
Actual temperature		0.0219* (0.115)		0.0203 (0.101)
Actual deviation		-0.0307 (-0.0905)		-0.0383 (-0.104)
Female			0.459 (0.103)	0.431 (0.0968)
Education			0.0184* (0.125)	0.0188* (0.128)
Age			0.0329 (0.0249)	0.0269 (0.0204)
Income (thousands)			0.00473* (0.143)	0.00416 (0.125)
Democrat (relative to Other)			-0.346 (-0.0774)	-0.318 (-0.0710)
Republican (relative to Other)			-0.477 (-0.0797)	-0.491 (-0.0820)
Constant	0.966*** (0.455)	0.966*** (0.455)	-0.222 (-0.0996)	-0.160 (-0.0716)
Observations	251	251	223	223
R ²	0.016	0.032	0.054	0.068

Note: Standardized regression coefficients in parentheses. Sample size is smaller for some regressions due to incomplete responses. * < .10, ** < .05, *** < .01.