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I N S T I T U T E

Public Knowledge About Polar Regions Increases While Concerns Remain Unchanged

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Introduction

How much do people know, and how much do they care, about environmental changes sweeping the north and south polar regions? Is there a connection between knowing and caring? These were some of the issues researchers had in mind as they prepared new questions to be part of the General Social Survey in 2006 and 2010. The polar questions covered topics such as climate change, melting ice and rising sea levels, and species extinction.¹ They formed a bookend to the International Polar Year in 2007–2008, which focused on scientific research along with outreach and education efforts to raise awareness of polar science.² The surveys were designed so that some individuals would be interviewed both years, and others only in 2006 or 2010. Although the Carsey Institute did not participate in the survey design or interviews, we are conducting the first comparative analysis of the polar questions.

The General Social Survey

The National Opinion Research Center (NORC) at the University of Chicago has conducted the General Social Survey (GSS) annually from 1972 to 1993 and biennially from 1994 to 2010.³ From 1972 to 2004, the GSS drew nationally representative samples of the English-speaking population aged 18 years or older, living in noninstitutional settings across the United States. Starting in 2006, the Spanish-speaking population was included as well.

We focus on two sets of questions from the GSS science module: a set of quiz-like questions that provide a brief test of general science knowledge, and another set on polar topics, including five questions assessing knowledge of the issues along with others assessing public concern about polar aspects of climate change.⁴ Scientists at the National Science Foundation's (NSF) Office of Polar Programs developed the polar questions, working with other researchers from the NSF directorate for

Key Findings

- The public's knowledge about the north and south polar regions, assessed by the General Social Survey, significantly improved between 2006 and 2010—before and after the International Polar Year.
- Although men tend to score higher on polar knowledge, this gender gap narrowed because much of the 2006–2010 improvement occurred among women.
- Unlike knowledge, there was no overall change in concern about polar aspects of climate change or support for reserving the Antarctic for science.
- Respondents who know more about science in general, and polar facts specifically, tend to be more concerned about polar changes such as endangered species, melting ice, and rising sea levels.
- More knowledgeable respondents also tend to favor reserving the Antarctic for science, rather than opening it for commercial development.
- Political outlook affects both levels of concern about polar environmental change and views on reserving the Antarctic.

Social, Behavioral, and Economic Sciences, the Science and Technology Policy Program of SRI International, the Survey Research Center at the University of Michigan, and NORC.

In 2010, the GSS began reinterviewing some of the same respondents interviewed in previous years to see whether their views had changed. The third wave of this panel data, released in 2010, includes three samples: 1) the newest

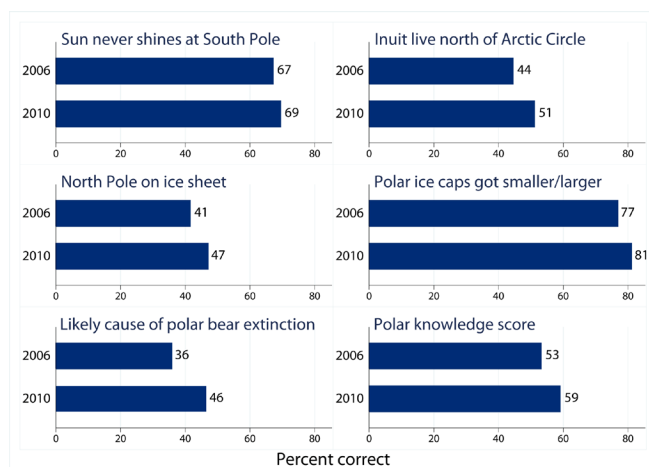
installment of the cross-sectional data from the 2010 panel, 2) the second interview of the 2008 panel, and 3) the third and final interview of the initial 2006 panel. This panel design adds another dimension to our analysis of whether public knowledge or concern about the Arctic and Antarctic changed between 2006 and 2010.

The GSS design allows us to compare 2006 with 2010 responses in two different ways. Our *cross-sectional* analysis compares responses from 1,553 people who answered polar questions only in 2006 with a different sample of 697 people who answered these questions in 2010 only. Both samples broadly represent the U.S. public in their respective years. Our *panel* analysis compares responses from 309 people who answered the same polar questions in 2006 and again in 2010, revealing any change in perceptions. The cross-section and the panel comparisons lead us to generally similar conclusions, suggesting that much of the change in knowledge we see reflects individuals becoming better informed.

Polar Knowledge

Box 1 lists the five polar knowledge questions, along with another set of eleven questions on general science topics (which define the “science literacy” score discussed later).⁵ The first five bar charts in Figure 1 compare percentages of 2006 and 2010 respondents in the cross-sectional analysis who answered each question correctly.⁶ The number of correct answers forms a respondent’s “polar knowledge score,” a simple index from 0 to 5. A chart at lower right in Figure 1 expresses this score as the percentage of questions answered correctly, graphing the mean percent for each year.

FIGURE 1. CROSS-SECTIONAL ANALYSIS: SHARE OF RESPONDENTS ANSWERING CORRECTLY ON FIVE POLAR KNOWLEDGE QUESTIONS, AND MEAN PERCENTAGE CORRECT OVERALL (“POLAR KNOWLEDGE SCORE”). NOTE: COMPARISON OF 2006 (1,553) AND 2010 (697) CROSS-SECTION RESPONDENTS ONLY.



Box 1

Polar Knowledge Questions

The GSS polar module included five questions meant to test knowledge about the north and south polar regions.

1. The North Pole is on a sheet of ice that floats on the Arctic Ocean (True/False)
2. The sun never shines at the South Pole (True/False)
3. Inuit (often called Eskimos) live north of the Arctic Circle (True/False)
4. Hunting is more likely than climate change to make polar bears become extinct (True/False)
5. Would you say the polar ice caps have gotten larger or smaller over the last 25 years?

From these five questions we constructed a “polar knowledge score” expressed as the percentage of questions answered correctly (Figures 1, 2, 3), or just as the number correct (Figures 7, 8).

General Science Knowledge

GSS survey science modules also asked eleven questions testing general knowledge of scientific terms and concepts.

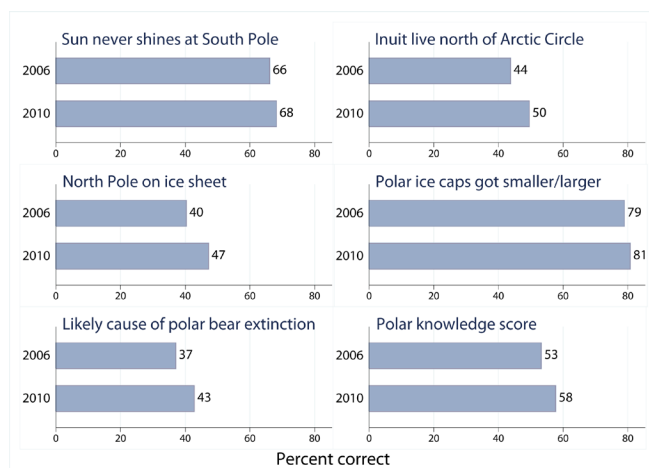
1. The center of the Earth is very hot. (True/False/Don't Know)
2. All radioactivity is man-made. (True/False/Don't Know)
3. It is the father's gene that decides whether the baby is a boy or a girl. (True/False/Don't Know)
4. Lasers work by focusing sound waves. (True/False/Don't Know)
5. Electrons are smaller than atoms. (True/False/Don't Know)
6. Antibiotics kill viruses as well as bacteria. (True/False/Don't Know)
7. The universe began with a huge explosion. (True/False/Don't Know)
8. The continents on which we live have been moving their locations for millions of years and will continue to move in the future. (True/False/Don't Know)
9. Human beings, as we know them today, developed from earlier species of animals. (True/False/Don't Know)
10. Does the Earth go around the Sun, or does the Sun go around the Earth?
11. How long does it take for the Earth to go around the Sun: one day, one month, or one year?

These eleven questions define the 0 to 11 point “science literacy score” used in previous research, and shown in Figures 7 and 8.

Figure 1 shows a pattern of mild but statistically significant improvement across each of the five questions and the overall polar knowledge score, with one exception (“sun never shines”).⁷ In 2006, for example, only 44 percent knew that Inuit live north of the Arctic Circle. In 2010, 51 percent answered correctly.

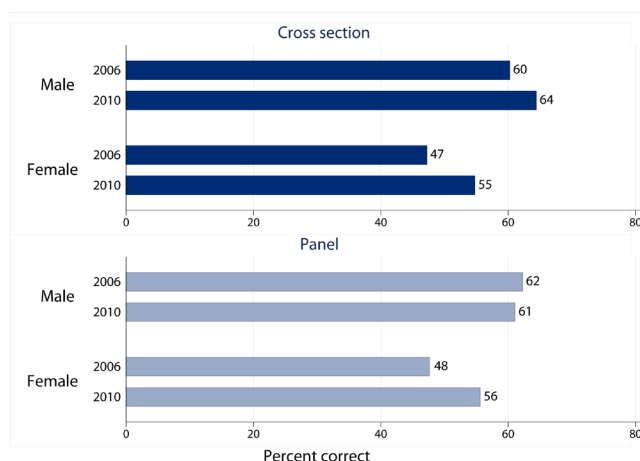
Figure 2 makes a similar comparison for the panel respondents. As in Figure 1, there is at least some improvement over time on each question. The percentage who are aware that Inuit live north of the Arctic Circle, for example, rose from 44 to 50 percent. The overall polar knowledge scores of panel respondents, like those in the cross-sections, rose by a modest but statistically significant amount. Although scientists and educators involved with the International Polar Year (IPY) perhaps hoped for greater improvement, IPY was successful in raising public awareness.⁸

FIGURE 2. PANEL ANALYSIS: SHARE OF RESPONDENTS ANSWERING CORRECTLY ON FIVE POLAR KNOWLEDGE QUESTIONS, AND MEAN PERCENTAGE CORRECT OVERALL (“POLAR KNOWLEDGE SCORE”). NOTE: 309 RESPONDENTS ANSWERED QUESTIONS IN 2006 AND AGAIN IN 2010.



Public knowledge improved, but improved for whom? Preliminary analysis finds an unexpected answer: although men had higher average scores, the improvement in polar knowledge occurred largely among women (Figure 3). The cross-sectional data show a rise of 8 percentage points (47 to 55 percent correct) among women, compared with just 4 percentage points (60 to 64 percent correct) among men. Female participants in the panel likewise improved by 8 points (48 to 56 percent), whereas men’s scores declined slightly (62 to 61 percent).

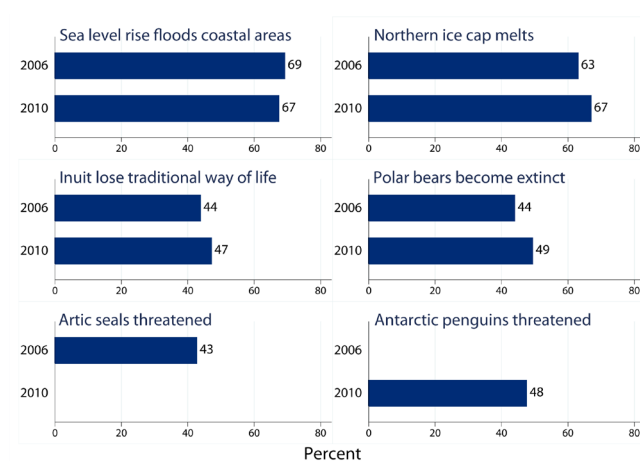
FIGURE 3. MEAN PERCENTAGE WITH CORRECT ANSWERS ON FIVE POLAR KNOWLEDGE ITEMS, BY GENDER.



Polar Concerns

While polar knowledge improved from 2006 to 2010, there was no general rise in concern about climate-related polar issues (questions in Box 2). Figure 4 draws the cross-sectional comparison. Only one increase (polar bears become extinct) reaches the level of statistical significance, while the percentage slightly declined for those who would be bothered a great deal if sea levels rose.⁹ The questions about seals being threatened (2006 only) and penguins being threatened (2010 only) are not strictly comparable, so the greater concern for penguins might just mean that they are more charismatic.

FIGURE 4. CROSS-SECTIONAL ANALYSIS: PERCENTAGE WHO SAY THEY WOULD BE BOTHERED A GREAT DEAL IF THESE CONSEQUENCES OF GLOBAL WARMING ACTUALLY HAPPENED. NOTE: COMPARISON OF 2006 (1,553) AND 2010 (697) CROSS-SECTION RESPONDENTS ONLY.



Box 2: Polar Concern Questions

Respondents were asked to what degree the following would bother them if the event described happened: a great deal, some, a little, or not at all.

1. Sea level may rise by more than 20 feet, flooding coastal areas.
2. The northern ice cap may completely melt.
3. Inuit and other native peoples may no longer be able to follow their traditional way of life.
4. By 2020, polar bears may become extinct.
5. Arctic seals may be threatened. (asked in 2006 only)
6. Antarctic penguins may be threatened. (asked in 2010 only)

We coded answers from 1 (not at all) to 4 (a great deal). Figures 4, 5, 7 and 8 show percentages who say they would be bothered a great deal if these hypothetical events happened.

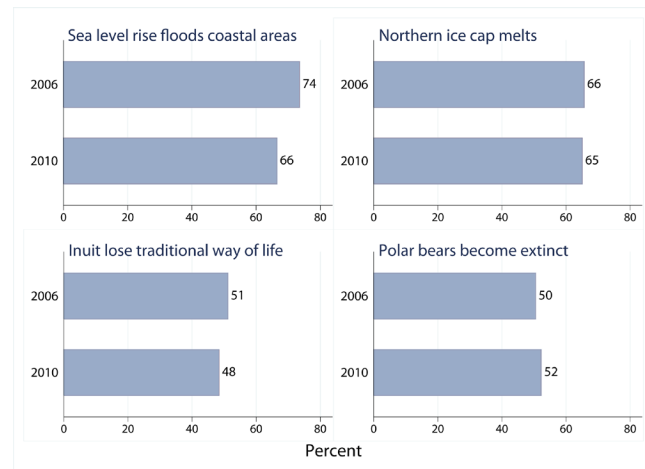
Respondents were asked whether the Antarctic should be reserved primarily for scientific purposes or opened for tourism, fishing, exploration for oil, and other commercial purposes. They were asked to choose the statement that best described their view on the issue.

- Strongly support opening Antarctica to other purposes.
- Somewhat support opening Antarctica to other purposes.
- Don't lean one way or another on this issue.
- Somewhat support reserving Antarctica for scientific purposes.
- Strongly support reserving Antarctica for scientific purposes.

Figure 6 shows all responses to this question. The lower charts in Figure 7 show the percentage who strongly or somewhat support reserving the Antarctic for science.

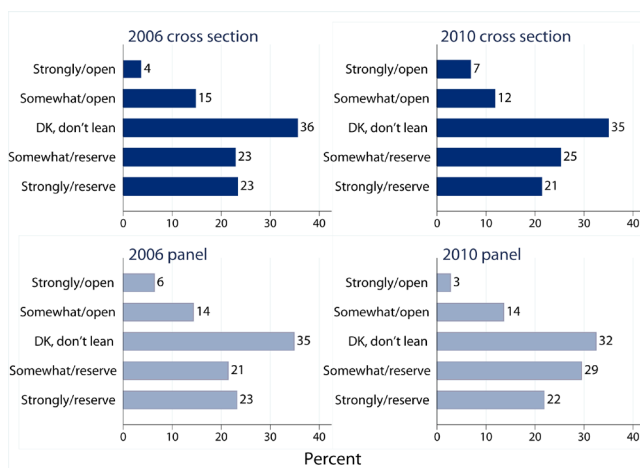
Among panel respondents (Figure 5), there is a somewhat larger and statistically significant decline in the percentage who would be bothered a great deal if sea levels rose. Concerns about Inuit losing their traditional way of life and northern ice melting exhibit small declines as well. Concern about polar bear extinction rose, but by a nonsignificant amount. Apart from the sea level question, Figures 4 and 5 show no clear direction of change over this period.

FIGURE 5. PANEL ANALYSIS: PERCENTAGE WHO SAY THEY WOULD BE BOTHERED A GREAT DEAL IF THESE CONSEQUENCES OF GLOBAL WARMING ACTUALLY HAPPENED. NOTE: 309 RESPONDENTS ANSWERED QUESTION IN 2006 AND AGAIN IN 2010.



On the question about whether to reserve Antarctica for science or open the continent for commercial development, respondents could choose along a continuum from “strongly support opening” to “strongly support reserving.” Figure 6 compares responses in both cross-sectional and panel data. Cross-sectional responses show no evidence of change: in both years, 46 percent support reserving the Antarctic for science. Among panel respondents, however, support for reserving the Antarctic rose from 44 to 51 percent.

FIGURE 6. RESPONSE TO THE QUESTION, “SHOULD ANTARCTICA BE OPENED FOR COMMERCIAL PURPOSES, OR RESERVED FOR SCIENCE?”

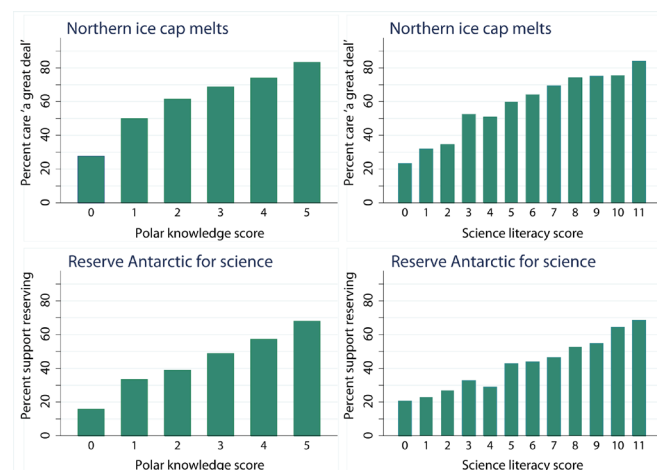


Overall, Figures 1–3 reveal higher knowledge in 2010 than 2006, consistent with a positive effect of IPY on knowledge. Figures 4–6, on the other hand, show little evidence of increasing concern.

Science Knowledge and Polar Concerns

As Figure 7 shows, respondents with greater science knowledge or awareness of polar facts are more concerned about polar environmental change.¹⁰ In the upper left, the percentage saying they would be bothered a great deal if northern ice melted is graphed against the polar knowledge score. The percentage of those concerned rises steadily with the knowledge score. In the lower left is a similar pattern: support for reserving Antarctica for science also rises with polar knowledge.

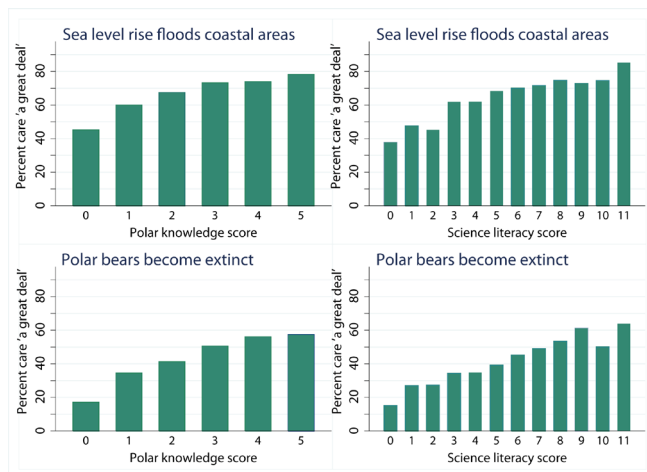
FIGURE 7. PERCENTAGE WHO ARE BOTHERED “A GREAT DEAL” IF NORTHERN ICE MELTS, AND PERCENTAGE WHO SUPPORT RESERVING ANTARCTICA FOR SCIENCE, BY POLAR KNOWLEDGE SCORE (0–5 ANSWERS CORRECT) AND SCIENCE LITERACY SCORE (0–11 CORRECT). THESE GRAPHS DEPICT POOLED RESPONSES FROM 2006 (CROSS-SECTION AND PANEL) AND 2010 (CROSS-SECTION ONLY) SAMPLES (N = 2,559).



Two of the five polar knowledge questions (ice sheets declining and polar bears at risk) refer to climate change, which makes the relationship in the upper left chart in Figure 7 less surprising. It is also not surprising that knowledge of polar facts correlates with support for polar science, as the lower left chart in Figure 7 shows. More interesting, however, are the very similar relationships involving a measure of general science literacy (see the right-hand charts of Figure 7). None of the topics involve climate or polar regions, yet general science literacy predicts both concern about melting Arctic ice and support for reserving the Antarctic.¹¹

Figure 8 shows similar relationships between knowledge and concern for two other issues, rising sea levels and polar bear extinction. Concern is graphed against the polar knowledge score on the left and against science literacy on the right. All four charts show patterns similar to those in Figure 7. Thus, people who know more about science tend to be more supportive of science, and they are more concerned about the implications of changes taking place in polar regions.

FIGURE 8. PERCENTAGE WHO WOULD BE BOTHERED “A GREAT DEAL” IF RISING SEA LEVELS FLOOD COASTAL AREAS, OR IF POLAR BEARS WERE TO BECOME EXTINCT, BY POLAR KNOWLEDGE SCORE (0–5 ANSWERS CORRECT) AND SCIENCE LITERACY SCORE (0–11 CORRECT). THESE GRAPHS DEPICT POOLED RESPONSES FROM 2006 (CROSS-SECTION AND PANEL) AND 2010 (CROSS-SECTION ONLY) SAMPLES (COMBINED N = 2,559).



More technical analysis, not shown here, confirms that the relationships between science knowledge and polar concerns graphed in Figures 7 and 8 remain statistically significant even after we control for age, gender, income, education, and political outlook.¹²

Discussion

People's knowledge of polar regions and issues improved slightly from 2006 to 2010, consistent with hopes that the International Polar Year would boost public awareness. This should not be interpreted solely as an IPY effect, however, because polar regions have been in the news for other reasons as well. For example, in August 2007, a Russian submarine planted a flag on the seafloor at the North Pole, dramatizing new and unresolved territorial claims in the warming and possibly resource-rich Arctic. Arctic sea ice fell to a record low in September 2007, leading scientists to ask whether seasonally ice-free conditions might arrive well before the second half of the century, affecting among other things polar bears and global climate. Nevertheless, IPY's outreach and education activities reached many people.

The more people know about polar regions or science in general, the more likely they are to be concerned about climate change. For example, only 38 percent of those with science literacy scores of zero say they would be bothered a great deal if sea level rose, flooding coastal areas. This increases to 70 percent among those who get 6 out of 11 questions right, and to 85 percent among those who get 11 out of 11 (Figure 8). Similar patterns occur with other measures in Figure 7 and 8: concern rises from very low levels among people who know none of the science facts, to large majorities among people who know all of them.

An understanding or awareness of the issues is not the only thing that shapes people's opinions, however. If rising concern were driven solely by polar knowledge, then concern levels should have risen as knowledge did, which did not occur. Ideology or politics also affect how people perceive polar issues.¹³ The 2006 and 2010 cross-sectional data show signs of increased political division (Democrat–Republican gaps widened by 6 to 10 percentage points) on each of the climate-related questions.¹⁴ Similarly, in the 2006 and 2010 panel data, the Democrat–Republican gap widened by 9 or 11 points on two questions and by one point on a third. Among concern items, only reserving Antarctica shows reduced divisiveness—but even so, support for reserving the Antarctic divides along party lines. Polar issues, like many other topics in science, increasingly are viewed by the public through politically tinted glasses.

ENDNOTES

1. Two earlier papers analyzed polar module results from the 2006 survey: L. C. Hamilton, "Who Cares About Polar Regions? Results From a Survey of U.S. Public Opinion," *Arctic, Antarctic, and Alpine Research*, vol. 40, no. 4 (2008): 671–678; X. Zhao, "Media Use and Global Warming Perceptions: A Snapshot of the Reinforcing Spirals," *Communication Research* 36(5) (2009):698–723.
2. I. Krupnik et al., eds. *Understanding Earth's Challenges: International Polar Year 2007–2008* (Edmonton, Alberta, Canada: International Council for Science WMO, 2011), available at www.icsu.org/publications/reports-and-reviews/ipy-summary/IPY-JC-Summary-Full.pdf.
3. This survey forms a keystone of the National Data Program for the Social Sciences, supported by the U.S. National Science Foundation. NORC, "General Social Survey," (Chicago: National Opinion Research Center, 2011), available at <http://www3.norc.org/GSS+Website>. All GSS data are publicly available and can be downloaded from the NORC website.
4. Major innovations in 1994 opened new areas for research. The GSS began carrying blocks of questions (modules) devoted to specific areas of scientific inquiry. We use the 2006 and 2010 topical modules on science, which include questions about respondents' knowledge, opinions and sources of information about science. See, National Science Board, *Science and Engineering Indicators 2010*. (NSB 10-01) (Arlington, VA: National Science Foundation, 2010).
5. For a different approach to measuring public knowledge specifically about climate change, see A. Leiserowitz, N. Smith, and J.R. Marlon, *Americans' Knowledge of Climate Change* (New Haven, CT: Yale University, Project on Climate Change Communication, 2010), available at <http://environment.yale.edu/climate/files/ClimateChangeKnowledge2010.pdf>.
6. All percentages graphed or discussed in this brief have been calculated using probability weights recommended by NORC, and supplied with GSS data.
7. Statements about statistical significance ($p < .05$ or lower) are based on tests appropriate for the specific question at hand. These include design-weighted F tests for tabulations of the cross-section data; weighted two-sample t tests for differences of means in the cross-section data; and symmetry tests or paired-difference t tests for tables or means in the panel data. Multivariate analysis (not shown) supports the main conclusions of this brief.
8. The 2006 to 2010 changes in polar knowledge scores are statistically significant at $p < .001$ level (cross-section respondents only) or $p < .05$ (paired-difference test of panel respondents).
9. The questions are posed as hypotheticals: How much would it bother you if these things actually happened? One of them (polar bears extinct by 2020) appears unrealistic, but others do not specify time scales, and have been widely discussed in scientific reports. From patterns such as partisan divisions in the responses, however, we suspect that some people responded as they did, not because they would be unbothered if rising sea levels flood coastal areas, for example, but because they do not believe this is likely to happen.
10. The sample represents 2,559 separate people, and does not count the 309 panel members in 2010 a second time.
11. Some people have questioned the inclusion of Big Bang and evolution items on the GSS science literacy list, arguing that those two items conflate knowledge with beliefs. See Y. Bhattacharjee, "NSF Board Draws Flak for Dropping Evolution from Indicators," *Science*, vol. 328, no. 5975 (April 9, 2010):150–151.
To check whether that issue affects our conclusions, we also drew versions of the right-hand bar charts in Figures 7 and 8 using only the other 9 science knowledge items. The modified charts have basically the same appearance. Science literacy, whether measured by the original GSS 0–11 scale or a truncated 0–9 version, is significantly related to all polar concern items in Box 2 except "Inuit lose their traditional way of life."
12. The knowledge/concern relationships graphed in Figures 7 and 8 remain significant in weighted ordered logit regression models where we control for several other knowledge indicators, as well as individual background characteristics such as age, gender, education, and political orientation.
13. For a detailed review and update on previous research, see A. M. McCright and R.E. Dunlap, "The Politicization of Climate Change and Polarization in the American Public's Views of Global Warming, 2001–2010," *The Sociological Quarterly*, vol. 52 (2011):155–194. An exploration of cultural and psychological factors that underlie conflicting perceptions about climate change and science appears in work by D.M. Kahan, H. Jenkins-Smith, and D. Braman, "Cultural Cognition of Scientific Consensus," *Journal of Risk Research*, vol. 14, no. 2 (2011):147–174. For detailed studies of the 2006 GSS on this topic, see Hamilton, "Who Cares About Polar Regions?" and Zhao, "Media Use and Global Warming Perceptions."
14. Increased polarization on polar items would be consistent with generally rising polarization on global warming or climate-related issues. See McCright and Dunlap, "The Politicization of Climate Change."

ACKNOWLEDGEMENTS

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