Chapter 7

Science and Technology: Public Attitudes and Understanding

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students had an advantage over adults in that classroom preparation preceded their tests. Research indicates that learning material, practicing it, and being tested on it periodically play a critical role in consolidating learning and helping individuals remember the information (Cepeda et al. 2008; Karpicke and Roediger 2008).

The variation patterns on these items were similar to the trend questions. However, men scored higher than women in all but one of the additional factual knowledge questions included in the GSS 2008 (appendix table 7-10 and 7-12).

International Comparisons

Adults in different countries and regions have been asked identical or substantially similar questions to test their factual knowledge of science. Knowledge scores for individual items vary from country to country, and no country consistently outperforms the others (figure 7-11). For the questions reported in figure 7-11, knowledge scores are relatively low in China, Russia, and Malaysia. Compared with the United States and the highly-developed countries in Europe, Japanese scores are also relatively low.[19]

Science knowledge scores vary considerably across the EU-25 countries, with northern European countries, led by Sweden, recording the highest total scores on a set of 13 questions. For a smaller set of four items that were administered in both 1992 and 2005 in 12 European countries, each country performed better in 2005. In contrast, the U.S. data on science knowledge do not show upward trends over the same period. In Europe, as in the United States, men, younger adults, and more highly-educated people tend to score higher on these questions (for more details on scientific literacy in individual countries in Europe, see NSB 2008).

Evolution and the "Big Bang"

In international comparisons, U.S. scores on two science knowledge questions are considerably lower than those in almost all other countries where the questions have been asked. Americans were less likely to answer "true" to the following scientific knowledge questions:

- "Human beings, as we know them today, developed from earlier species of animals."
- "The universe began with a huge explosion."

In the United States, 45% of GSS respondents answered true to the first question in 2008, similar to other years when the question was asked. In other countries and in Europe, the comparable figures were higher: 78% in Japan, 70% in Europe, 69% in China, and 64% in South Korea. Russia and Turkey were the only countries where less than half of respondents responded correctly (44% and 27% respectively) (Gokhberg and Shuvalova, 2004; EC 2005). Similarly, Americans were less likely than survey respondents in South Korea and Japan to answer the big bang question correctly: one-third of Americans answered this question correctly compared with 67% of South Korean and 63% of Japanese respondents (figure 7-11).

Americans' responses to questions about evolution and the big bang appear to reflect factors beyond familiarity with basic elements of science. An experiment conducted in the 2004 Michigan Survey of Consumer Attitudes showed that respondents were more likely to answer these two questions correctly when the questions were prefaced by "according to the theory of evolution" or "according to astronomers." These differences probably indicate that many Americans hold religious beliefs that cause them to be skeptical of established scientific ideas, even when they have some basic familiarity with those ideas (for additional details see NSB 2008).

Recent surveys conducted by the Gallup Organization provide similar evidence. A 2009 survey showed that more than half (55%) of Americans could correctly name evolution or another closely associated term, such as natural selection, when asked which scientific theory they associate with Charles Darwin. However, in a follow-up question, only 39% of Americans say they believe in the theory of evolution, 25% say they do not believe in this theory, and 36% do not have an opinion on this subject either way (Newport 2009).

In response to another group of questions on evolution asked by Gallup in 2008, 43% of Americans agreed with the statement that "God created human beings pretty much in their present form at one time within the last 10,000 years or so," while the 52% agreed with either of two statements compatible with the theory of evolution: that

human beings developed over millions of years either with or without God's guidance in the process (figure 7-12). These views on the origin of human beings have remained virtually unchanged in nine surveys since the questions were first asked in 1982 (The Gallup Organization 2008c).

For almost a century, whether and how evolution should be taught in U.S. public school classrooms has been a frequent source of controversy. The role of alternative perspectives on human origins, including creationism and intelligent design, and their relevance to the teaching of science, has likewise been contentious (The National Academies 2008a). A recent national survey of high school biology teachers in public schools shows that there is a large variation in how teachers approach the topic of evolution. How they teach evolution, in turn, affects public knowledge (see sidebar, How Schools Teach Evolution).

In other developed countries, controversies about evolution in the schools have occurred more rarely. However, signs of opposition to the theory of evolution are emerging in Europe (Clery 2008, *Nature* 2006).

How Schools Teach Evolution

A national survey found that high-school biology teachers devoted an average of 13.7 hours to the theory of evolution over the course of the school year (Berkman, Pacheco, and Plutzer 2008). Nearly all high school biology teachers addressed evolution in some form. Virtually all (98%) devoted some time to general evolutionary processes, and 83% covered human evolution.[20]

However, teachers differed significantly in their views about the importance of evolution to their courses. Six in ten strongly agreed with the statement that "evolution serves as the unifying theme for the content of the course." Those who strongly agreed (23%) devoted a higher number of hours to evolution (18.5) than other teachers. Most (82%) disagreed with the statement "It is possible to offer an excellent general biology course for high school students without mentioning Darwin or evolutionary theory," but 13% said they agreed.

About one-quarter of the teachers devoted at least some time to creationism or intelligent design (18% between 1-2 hours; 5% between 3-5 hours; and 3% between 6-20 hours). Almost half of these teachers agreed with the statement "I emphasize that this is a valid, scientific alternative to Darwinian explanations for the origin of the species."

Why do some teachers spend much more time on the theory of evolution than others? The authors dismiss the variation on state curricular standards as at most a minor factor affecting coverage of this subject and conclude that teachers' personal beliefs about evolution are one of the main factors affecting the amount of time teachers spend on this subject.

In response to a question that has been asked in Gallup surveys over the years, 16% of teachers agreed with the statement that "God created human beings pretty much in their present form at one time within the last 10,000 years or so" (figure 7-12). Teachers who expressed this view

devoted 35% fewer class hours to evolution than all the other teachers. In addition, teacher qualifications were associated with the amount of time teachers devote to evolution in the classroom. High school teachers who completed the most number of college-level credits in biology and life science classes and whose coursework included at least one class in evolutionary biology devoted 60% more time to evolution than teachers with the fewest credits in these areas.

(end sidebar)

Reasoning and Understanding the Scientific Process

Past NSF surveys have used questions on three general topics—probability, experimental design, and the scientific method—to assess trends in Americans' understanding of the process of scientific inquiry. One set of questions tests how well respondents apply principles of probabilistic reasoning to a series of questions about a couple whose children have a one-in-four chance of suffering from an inherited disease.[21] A second set of questions deals with the logic of experimental design, asking respondents about the best way to design a test of a new drug for high blood pressure. An open-ended question probes what respondents think it means to "study something scientifically." Because probability, experimental design, and the scientific method are all central to scientific research, these questions are relevant to how respondents evaluate scientific evidence.

In 2008, 65% of Americans responded correctly to the two questions about probability, 38% to the questions testing the concept of experiment, and 22% to the questions testing the concept of scientific study. Scores in the probability questions fluctuate each year but are relatively stable over time; however, between 2006 and 2008 the combined scores of the two probability questions declined. Scores in the other scientific process questions were generally higher than they were in the mid-1990s, but decreased somewhat in 2008 (appendix table 7-13). Performance on these questions is strongly associated with the different measures of science knowledge and education (appendix table 7-14). Older Americans and those with lower incomes, two groups that tend to have less education in the sciences, also score lower on the inquiry measures. Men and women obtain similar scores in these questions (table 7-4 and table 7-6).

The 2008 GSS included several additional questions on the scientific process that provide an opportunity to examine Americans' understanding of experimental