

**Chapter 4**

# **Benefits and Risks From Science**

# Benefits and Risks From Science

---

Public perceptions of the risks and benefits of genetic engineering and biotechnology are probably developed within a more general context of public beliefs about science. What are the perceptions of the public concerning the risk-benefit equation for the broad issues of science and technology?

The OTA survey found that the American people say they are basically optimistic about scientific progress and technological development. **A large majority of the public expects developments in science and technology in the next 20 years to benefit them and their families. Although the public says it expects some risks from scientific and technological developments, the large majority believes that the ben-**

**efits to society from technological innovation will outweigh the risks. The risks of scientific and technological development are frequently viewed as overstated and overblown.**

**Despite the basically positive orientation of the public toward scientific growth and technological progress, there is evidence of growing public support for increased control over technological development.** Although a plurality still favors maintaining the current degree of regulatory control over science and technology, the proportion that says it favors increased control has risen from 31 to 43 percent over the past decade. There is a consensus in favor of technological growth, but control over perceived risks is increasingly important to the public.

## BENEFITS FROM SCIENCE

Self-interest could be the cornerstone of American perceptions of science. The OTA survey clearly demonstrates that most Americans believe they and their families will personally benefit from developments in science and technology over the next 20 years. The survey found that 41 percent of Americans say they expect “a lot” of benefit for themselves and their families from developments in science and technology over the next two decades, and a nearly equal number (39 percent) say they expect “some benefit” to be gained from scientific developments. Fewer than one in five Americans reports expecting “little” (14 percent) or “no” (5 percent) personal benefit from science and technology (table 12).

Public expectations concerning the benefits of science increase with education. Only 28 percent of those without a high school degree say they expect a lot of benefit from science and technology. In contrast, 57 percent of college graduates say they expect developments in science and technology to bring a lot of benefit.

The perceived benefits of scientific developments also vary with age. Nearly half (48 percent) of those who are 35 to 49 years old say they expect a lot of benefit from developments in the next 20 years. Younger adults—18 to 34—believe themselves somewhat less likely to benefit a lot from scientific and technological developments (42 percent). Those 50 to 64 years old (34 percent) and 65 and over (33 percent) say they are less likely to anticipate a lot of personal benefit from scientific and technological advances.

**Despite variations associated with age or education, a majority of all demographic subgroups investigated says it expects at least some benefit to themselves and their families from future developments in science and technology. And, importantly, Americans say they expect personal benefits from scientific growth to continue for the near future.**

Table 12.—Amount of Benefit From Science

Question (Q5): <sup>a</sup> How much benefit do you expect you and your family to get from developments in science and technology in the next 20 years—a lot of benefit, some benefit, little benefit, or no benefit?						
	A lot	Some	Little	None	Not sure	
<b>Total</b> .....	<b>(1,273)<sup>b</sup></b>	41%	39%	14%	5%	2%
<i>Age:</i>						
18 to 34.....	(546)	42	40	14	3	1
35 to 49.....	(343)	48	38	12	2	1
50 to 64.....	(252)	34	37	15	9	
65 and over.....	(127)	33	37	15	11	3
<i>Education:</i>						
Less than high school.....	(165)	28	41	16	12	3
High school graduate.....	(458)	39	39	17	4	
Some college.....	(300)	45	40	10	3	2
College graduate.....	(347)	57	35	6	1	1
<i>Science understanding:</i>						
Very good.....	(236)	56	31	7	3	3
Adequate.....	(707)	41	40	14	4	1
Poor.....	(316)	31	40	17	9	3
<i>Science orientation:</i>						
Observant.....	(626)	51	33	10	4	3
Nonobservant.....	(647)	32	44	17	6	1
<i>Party affiliation:</i>						
Republican.....	(435)	45	40	11	3	1
Independent.....	(334)	40	39	14	5	
Democrat.....	(441)	38	37	16	7	3

<sup>a</sup>The code number of the question in the survey instrument (see app. B)

<sup>b</sup>Percentages are presented as weighted sample estimates. The unweighted sample base is presented in parentheses so that the sampling variance for these estimates can be calculated.

SOURCE: Office of Technology Assessment, 1987.

## RISKS FROM SCIENCE

Counterpoint to the benefits of scientific growth are the potential risks new technology could entail. Survey respondents, therefore, were asked the degree of risk to themselves and their families that developments in science and technology might cause over the next 20 years. Slightly more than a fifth (22 percent) feel that advances in science and technology will cause “a lot” of risk to them and their families. Nearly half (49 percent) believe that these developments will pose “some” risk. The rest of the public says it sees “little” (20 percent) or “no” (7 percent) risk from scientific or technological advances during the next two decades (table 13).

A substantial difference exists in the perception of the likelihood of risks and benefits from scientific and technological developments. Nearly twice as many people (41 percent) expect a lot of benefits as expect a lot of risk (22 percent). But, the perceived cost-benefit ratio of such development

varies across subgroups of the population. Among the college educated, for example, 57 percent say they expect a lot of benefit, while only 18 percent state they expect a lot of risk. In contrast, for those without a high school diploma, there is little difference between the proportion that says it expects a lot of benefit from scientific and technological developments (28 percent) and the group that says it expects a lot of risk (24 percent).

The difference in cost-benefit of scientific and technological development is primarily on the benefit side of the equation. Subgroups differ little in their estimate of the risk. There is no measurable difference in the proportion that believes there is a lot of risk from scientific and technological developments among those 18 to 34 years old (21 percent), those 35 to 49 (20 percent), and those 50 to 64 years old (22 percent)—although those 65 and over are slightly more likely to state they expect a lot of risk (27 percent).

Table 13.—Amount of Risk From Science

Question (Q6): <sup>a</sup> How much risk to you and your family do you think developments in science and technology will cause in the next 20 years—a lot of risk, some risk, little risk, or no risk?					
	A lot	Some	Little	None	Not sure
<b>Total</b> . . . . . (1,273) <sup>b</sup>	22%	490/0	200/0	7%	20/0
<i>Age:</i>					
18 to 34 . . . . . (546)	21	50	22	6	1
35 to 49 . . . . . (343)	20	53	18	7	2
50 to 64 . . . . . (252)	22	44	21	11	2
65 and over . . . . . (127)	27	45	15	8	5
<i>Education:</i>					
Less than high school . . . . . (165)	24	40	24	10	3
High school graduate . . . . . (458)	22	52	17	7	1
Some college . . . . . (300)	23	49	21	5	2
College graduate . . . . . (347)	18	53	20	7	2
<i>Science understanding:</i>					
Very good . . . . . (236)	22	42	23	10	3
Adequate . . . . . (707)	22	50	19	7	1
Poor . . . . . (316)	22	49	19	6	4
<i>Science orientation:</i>					
Observant . . . . . (626)	23	46	20	9	2
Nonobservant . . . . . (647)	21	51	20	6	2
<i>Party affiliation:</i>					
Republican . . . . . (435)	17	51	23	7	2
Independent . . . . . (334)	23	51	16	8	2
Democrat . . . . . (441)	24	46	20	7	2

<sup>a</sup>The code number of the question in the survey instrument (see app.B.)

<sup>b</sup>Percentages are presented as weighted sample estimates. The unweighted sample base is presented in parentheses so that the sampling variance for these estimates can be calculated.

SOURCE: Office of Technology Assessment, 1987.

Education also does not influence the expectation that a lot of risk will be caused by scientific and technological innovation. The proportion that reports it expects a lot of risk is about the same among those with less than a high school diploma (24 percent), high school graduates (22 percent), and those with some college (23 percent). Those with college degrees are only slightly less likely to say they expect a lot of risk (18 percent).

Finally, there is no difference in the proportion that says it expects a lot of risk among those who feel that their understanding of science is very good (22 percent), adequate (22 percent), or poor

(22 percent). Similarly, the science observants (23 percent) and the science nonobservants (21 percent) are about equally likely to say they expect a lot of risk from scientific and technological developments.

Thus, concern about the personal risks of scientific and technological development appears to be uniform across most subgroups of the general American populace. Neither age, education, nor science observance substantially affects concern about risks of scientific development. This survey does not pinpoint the source of this background fear of technological risks.

## RISKS V. BENEFITS

A comparison of the public perceptions of benefits and risks from science suggests that the public sees more benefit than risk. When the amount of personal benefit from scientific and technological developments is cross-tabulated with the amount of risk expected, a plurality (43 percent)

reports more benefits than risks (e.g., a lot of benefit and some risk). Another 30 percent say they expect the same general level of risk and benefit from scientific and technological developments (e.g., some benefit and some risk), and 21 percent say they expect more risk than benefit from sci-

Table 14.—Comparison of Amounts of Risk and Amounts of Benefit<sup>a</sup>

	A lot of risk	Some risk	Little risk	No risk	Not sure
Question (Q5): <sup>b</sup> How much benefit do you expect you and your family to get from developments in science and technology in the next 20 years—a lot of benefit, some benefit, little benefit, or no benefit?	7%	22%	70%	3%	1%
Question (Q6): How much risk to you and your family do you think developments in science and technology will cause in the next 20 years—a lot of risk, some risk, little risk, or no risk?	4	5	3	1	<1
A lot of benefit . . . . .	7%	22%	70%	3%	1%
Some benefit . . . . .	4	5	3	1	<1
Little benefit . . . . .	2	1	1	1	<1
No benefit . . . . .	1	<1	<1	<1	< 1
Not Sure . . . . .	1	<1	<1	<1	< 1

<sup>a</sup>Percentages are presented as weighted sample estimates. The unweighted base from which the sampling variance can be calculated is 1,273.

<sup>b</sup>The code number of the question in the survey instrument (see app. B.)

SOURCE: Office of Technology Assessment, 1987.

ence and technology (e.g., some benefit and a lot of risk) (table 14).

These general categories of risk and benefit, however, mask how widespread the belief is that benefits exceed risks. To measure this basic orientation toward risks or benefits, the surveyed Americans were asked:

In your opinion, over the next 20 years will the benefits to society resulting from continued technological and scientific innovation outweigh the related risks to society or not?

Faced with this fundamental choice, a majority of the American public (62 percent) says it believes that the benefits of continued technological and scientific innovation “will outweigh the related risks.” A minority (28 percent) of the public feels the “benefits will not outweigh the risks.” Smaller segments of the public say they are “not sure” (7 percent) or say it “depends” (4 percent) (table 15).

## PUBLIC OPTIMISM

**While the OTA survey documented a decline in public interest in science, it found no measurable decline in public optimism toward science during the 1980s.** In 1980, 58 percent of the American public felt the benefits of scientific developments would outweigh the risks (1). The OTA survey found that an even larger proportion of the public (62 percent) feels that the benefits of scientific innovation outweigh the risks,

Education appears to be the central influence in an individual’s assessment of the cost-benefit outcome of scientific innovation. Half (50 percent) of those without a high school degree believe that the benefits will outweigh the risks. In contrast, three quarters (74 percent) of college graduates surveyed by OTA believe the benefits will outweigh the risks.

Age also has an effect on the perceived balance of risks and benefits of scientific and technological development. Individuals in the younger age bracket seem more concerned about the risks of innovation. Although only a fifth (20 percent) of those aged 65 and older believe the benefit will not outweigh the risks of scientific and technological development, this perception is held by nearly a third (32 percent) of those 18 to 34 years old.

The stability in public optimism about science is curious, given the 6-percentage-point decline between 1982 and 1986 in the numbers of people who say they are very interested in science, and the 10-percentage-point decline in those who are somewhat interested (58 to 48 percent). Since public confidence that the benefits of scientific innovation will outweigh the risks has increased, the waning interest in science and technology

Table 15.—Weighing the Benefits of Science v. Risks

Question (Q7): <sup>a</sup> In your opinion, over the next 20 years will the benefits to society resulting from continued technological and scientific innovation outweigh the related risks to society, or not?					
		Benefits will outweigh risks	Benefits will not outweigh risks	Depends	Not sure
Total 1986 .....	(1,273)	62%	2%	4%	7%
1980 .....	§	58	25	3	14
<i>Age:</i>					
18 to 34 .....	(546)	60	32	2	5
35 to 49 .....	(343)			4	
50 to 64 .....	(252)	62	27	4	6
65 and over .....	(127)	60	20	7	12
<i>Education:</i>					
Less than high school .....	(165)	50	37	4	
High school graduate .....	(458)		30	2	9
Some college .....	(300)	69	20	5	6
College graduate .....	(347)	74	16	6	4
<i>Science understanding:</i>					
Very good .....	(236)	66	27	3	4
Adequate .....	(707)	64	26	4	6
Poor .....	(316)	56	31	4	9
<i>Science orientation:</i>					
Observant .....	(626)	68	22	4	5
Nonobservant .....	(647)	56	33	3	8
Voters .....	(935)	65	24	5	6

<sup>a</sup>The code number of the question in the survey instrument (see app. B.)

<sup>b</sup>Percentages are presented as weighted sample estimates. The unweighted sample base is presented in parentheses so that the sampling variance for these estimates can be calculated.

<sup>c</sup>Louis Harris & Associates, *Risk in a Complex Society*, 1980.

SOURCE: Office of Technology Assessment, 1987.

among the less educated subgroups is probably not a result of fear. Likewise, the decreased interest cannot be attributed to declining confidence in science.

What is striking about the survey findings is the resilience of American confidence in science and technology in the face of major setbacks in 1986.

- In January 1986, the space shuttle Challenger exploded, followed by a series of failed rocket launches.
- Only a year after the disastrous chemical release in Bhopal, India, a major chemical spill in Europe poisoned the Rhine River in 1986.

- Less than a decade after the nuclear accident at the Three Mile Island nuclear plant in the United States, much of Europe was affected by the release of radiation from the Soviet nuclear plant catastrophe at Chernobyl.

Yet, in the face of one of the most disastrous years in memory for high technology, the OTA survey found that a great majority of the public continues to believe that the benefits of scientific development outweigh the risks, and that confidence in science and technology appears to have increased, not decreased.

## BELIEFS ABOUT TECHNOLOGICAL RISK

The public expresses mixed opinions about the risks of scientific and technological development. On the one hand, the public says it is genuinely concerned about the unforeseen consequences of modern technology. A sizable majority (61 per-

cent) says it agrees with the proposition that: "Society has only perceived the tip of the iceberg with regard to the risks associated with modern technology." A majority of college graduates (54 percent) also states its agreement.

On the other hand, much of the public also believes that the problems of technological development may have been blown out of proportion. A majority of the public (54 percent) agrees with the proposition: "The risks associated with advanced technology have been exaggerated." An

even larger majority (59 percent) reports it takes the position: "Most of the risks of new technology that people worry about never really happen." Individuals in all educational categories share this sense that the true risks of technological development have been overblown (table 16).

Table 16.—Beliefs About the Risks of Science

Question (Q8a-d): <sup>a</sup> Thinking about society as a whole, please tell me whether you tend to agree or disagree with each of the following statements. (READ EACH STATEMENT)					
	Total	Education			
		Less than high school	High school graduate	Some college	College graduate
	(1,273) <sup>b</sup>	(165)	(458)	(300)	(347)
<b>a. Unless technological development is restrained, the overall safety of our society will be jeopardized significantly in the next 20 years.</b>					
Agree . . . . .	42%	50%	45%	42/0	23/0
Disagree . . . . .	54	46	50	55	74
<b>b. The risks associated with advanced technology have been exaggerated.</b>					
Agree . . . . .	54	58	52	50	53
Disagree . . . . .	43	38	44	46	43
<b>c. Society has only perceived the tip of the iceberg with regard to the risks associated with modern technology.</b>					
Agree . . . . .	61	65	62	62	54
Disagree . . . . .	33	28	33	34	42
<b>d. Most of the risks of new technology that people worry about never happen.</b>					
Agree . . . . .	59	59	59	57	63
Disagree . . . . .	37	36	38	40	33

<sup>a</sup>The code number of the question in the survey instrument (See app. B.)

<sup>b</sup>Percentages are presented as weighted sample estimates. The unweighted sample base is presented in parentheses so that the sampling variance for these estimates can be calculated.

SOURCE: Office of Technology Assessment, 1987.

## GROWTH AND CONTROL OF SCIENCE AND TECHNOLOGY

In general, Americans report they are comfortable with the current rate of growth of science and technology. A minority believes the rate of growth is "much too fast" (9 percent) or "a little too fast" (16 percent). A somewhat larger number feels the rate of growth is "a little too slow" (22 percent) or "much too slow" (5 percent). But a plurality (43 percent) says it thinks the current rate of growth of science and technology in the country is "about right" (table 17).

While a majority (54 percent) of the public says it disagrees with the notion: "Unless technological development is restrained, the overall safety of our society will be jeopardized significantly in the next 20 years," there are large differences among subgroups. Among those without high school degrees, 50 percent believe that technological restraints are necessary, while 46 percent believe they are not. There is disagreement among high school graduates (50 to 45 percent) and those

Table 17.-Rate of Growth of Science and Technology

Question (Q4): <sup>a</sup> Do you think that the current rate of growth of science and technology in this country is: much too fast, a little too fast, about right, a little too slow, or much too slow?					
	Total	Education			
		Less than high school	High school graduate	Some college	College graduate
	(1,273) <sup>b</sup>	(165)	(458)	(300)	(347)
Much too fast . . . . .	9%	12%	10%	8/0	4%
A little too fast . . . . .	16	14	18	16	17
About right . . . . .	43	44	43	43	43
A little too slow . . . . .	22	20	22	24	26
Much too slow . . . . .	5	7	4	5	7
Not sure . . . . .	3	3	4	4	2

<sup>a</sup>The code number of the question in the survey instrument (See app. B.)

<sup>b</sup>Percentages are presented as weighted sample estimates. The unweighed sample base is presented in parentheses so that the sampling variance for these estimates can be calculated.

SOURCE Office of Technology Assessment, 1987

with some college (55 to 42 percent) that restraint is necessary. Among college graduates, greater than a 3 to 1 ratio (74 to 23 percent) says it rejects the notion that unrestrained technological development will jeopardize the safety of our society (table 16).

The 42 percent minority that feels unrestrained growth in technology will jeopardize the safety of society (table 16) is similar to the 43 percent of the public who believe that the degree of control society has over science and technology should be increased. A plurality, however, believes that the current degree of control should remain as it is (46 percent); and a small minority (8 percent) believes that the current degree of control should be decreased (table 18).

Although a majority of the public still appears to be comfortable with the present degree of regulation and control over technological growth, there is evidence that demand for stricter controls might increase. A National Science Foundation survey also found that the proportion of the

public favoring expanded control increased from 28 percent in 1972 to 31 percent in 1976; a decade later this value reached 43 percent in favor of increased control (i'). Should the present rate of increase continue, a majority of the public might favor regulation within a decade. The OTA survey reports that at present, a slim majority of Democrats (51 percent) says it already favors increased control. On the other hand, a majority of Republicans believes that the present level of control should remain as is (53 percent) or be decreased (9 percent).

**In summary, Americans remain optimistic about the benefits of scientific growth and technological development. They continue to believe that the benefits of scientific innovation outweigh the risks. The public does, however, express a substantial level of concern about technological risks and unrestrained scientific growth, and Americans appear to increasingly favor greater regulation of scientific development.**

Table 18.—Degree of Control Over Science and Technology

Question (Q8): <sup>a</sup> Overall, do you think the degree of control that society has over science and technology should be increased, should be decreased, or should remain as it is now?					
		increased	Decreased	Remain as is	Not sure
Total 1886	(1,273) <sup>b</sup>	43%	8%	46%	2%
1976 <sup>c</sup>	(2,108)	31	10	45	14
1972 <sup>d</sup>	(2,209)	28	7	48	17
<i>Education:</i>					
Less than high school	(165)	38	11	49	2
High school graduate	(458)	46		43	2
Some college	(300)		41	41	2
College graduate	(347)	36	7	54	3
<i>Science orientation:</i>					
Observant	(626)	43	9	46	2
Nonobservant	(647)	44	8	46	2
<i>Risk/benefits:</i>					
Benefits	(829)	39	8		
Risks	(316)	53	6	38	2
Voters <sup>e</sup>	(935)	44	8	46	2
<i>Party affiliation:</i>					
Republican	(435)	37	9	53	2
independent	(334)	42	9	47	2
Democrat	(441)	51	7	39	3

<sup>a</sup>The code number of the question in the survey instrument (see app. B)

<sup>b</sup>Percentages are presented as weighted sample estimates. The unweighted sample base is presented in parentheses so that the sampling variance for these estimates can be recalculated.

<sup>c</sup>National Science Board, National Science Foundation, *Science Indicators, 1976: An Analysis of the State of U.S. Science and Engineering, and Technology* (Washington, DC: U.S. Government Printing Office, 1977).

<sup>d</sup>National Science Board, National Science Foundation, *Science Indicators, 1972: An Analysis of the State of U.S. Science and Engineering, and Technology* (Washington, DC: U.S. Government Printing Office, 1973).