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EUROPEANS, SCIENCE AND TECHNOLOGY

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INTRODUCTION

The main focus of this paper is a public opinion survey on science and technology, carried out for the Commission of the European Communities in 1989. Before presenting some highlights of the survey and in order to put it in a context, the involvement of the European Communities in science and technology and the rationale that led to this survey will be outlined.

The EC has been involved in R&D from the very beginning, some 40 years ago and what started then as a relatively modest activity primarily on nuclear energy, has emerged as a substantial effort that now encompasses a wide range of fields including health, environment, telecommunications, energy, information technology, agriculture and fisheries and so on. Well-known examples are ESPRIT, BRITE, RACE and JET. Annual Community spending on Research and Technological Development (RTD) is on the order of 2 billion ECU and represents currently 5% of all public civil RTD spending in the EC. These RTD activities complement those of the Member States, among which the EC also seeks to establish and increase coordination of their RTD programs and policies. After the modification of the EEC Treaty in 1987, the Community Research and Technological Development Policy has become a major policy of the EC.

Increasingly, important choices have to be made on science and technology issues at all levels in society: science and technology are increasingly interwoven in the societal fabric and a number of science and technology issues have become subject of broad public concern and debate. To assure harmonious development, this increasing societal dimension is reflected in policy formulation both at Community and at national level. In this context a number of issues have surfaced that are worrying policy makers and that concern interest, knowledge and attitudes of the public at large as concerns science and technology. Studies carried out by Miller in the United States and in the United Kingdom in 1988 show that over 90% of the population is to be considered scientifically illiterate. The public to a large extent appears not sufficiently informed to evaluate the options offered by scientific and technological development. One way of measuring the extent of the problem and to bring this issue into the debate is through public surveys.

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Against this background, it was decided to measure the situation in the European Community as a whole through a Community-wide survey, which was commissioned by the Directorate General for Science, Research and Development and carried out in the frame of EUROBAROMETER[5] in the spring of 1989. Although during the preceding years occasionally science and technology questions had been asked in EUROBAROMETER surveys, this survey was the first major one since 1978. Over 11,500 Europeans in the twelve member states of the European Community were asked about 50 questions about interest, information acquisition, knowledge, understanding and opinions on science and technology, the position of Europe with respect to the United States and Japan, about their knowledge of, and opinion on, the research and development activities of the EC and on their views as to the areas in which the European Community should develop policies in view of the completion of the common market in 1992.

As a result of the growing world-wide activities in public opinion surveys on science and technology there is a matching increasing interest in international comparison of the results. In order to provide for a certain comparability, the survey included a number of questions that had been used in 1988 in surveys carried out by two of the authors, prof. J. Durant and prof. J. Miller, in the United Kingdom and in the United States respectively. However, comparisons of the results of surveys carried out in different countries should not made without caution. Further study is necessary to assess the effects of methodological and other differences between surveys in different countries and to increase confidence in comparing the results.

A comparative presentation of the main results of the EC and USA studies as concerns public understanding of, interest in, and attitudes towards science and technology is given in the first part of the paper. The second part reports on the results of questions that specifically relate to science and technology in the EC. The third part discusses in more general terms the problems and prospects of international comparability of surveys on science and technology.

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[5] EUROBAROMETER is a service within the Directorate General "Information, Communication and Culture" of the Commission of the European Communities. EUROBAROMETER performs regular public opinion surveys in the twelve Member States of the European Communities.

I. UNDERSTANDING, INTEREST AND ATTITUDES

The Public Understanding of Science and Technology

One of the objectives of the 1989 study was to examine the level of public understanding of science and technology in the European Community. How many Europeans understand the structure of our solar system, or the continental drift? How many Europeans understand simple probability statements or the likely range of effectiveness of antibiotics ? How many Europeans understand the nature of a scientific study ?

We should like to point out, that survey data may be analyzed in a variety of ways. In a second paper, presented after this, one of us will use a measure of scientific knowledge based on twelve elementary factual questions, some of which are shown in Table 1. Here, however, we shall present an analysis using a conceptualization of scientific literacy developed by Professor Miller, from the United States, and employed by the U.S. National Science Foundation in its periodic studies of the public understanding of science and technology since 1979. Professor Miller argues that a scientifically literate adult should

1. have a basic vocabulary of scientific terms and concepts adequate to read reports about scientific disputes in a daily newspaper or a science magazine,
2. understand the scientific approach sufficiently to be able to distinguish between real science and pseudo-science, and
3. be aware of some of ways in which science and technology influence our daily lives as citizens, consumers, and workers.

Using this conceptualization, Miller has measured the level of scientific literacy in the United States in 1979, 1985, 1988 and 1990. Given the large number of common questions asked in the 1989 European Community and 1988 United States study, it is possible to construct comparable measures of each of these three dimensions for the EC and for the United States. It is useful to review briefly the components included in each of these three dimensions that lead to an estimate of scientific literacy.

The measure of the level of understanding of scientific terms and concepts is based on a set of eight common items included in the two studies. Respondents who were able to provide six or more correct responses to these items (see Table 1) were classified as having a minimally acceptable vocabulary of scientific and technical terms. In general, the patterns of responses were similar in the EC and in the US, but Americans were significantly less likely to respond correctly to the items on evolution and the relative ages of humans and dinosaurs. Europeans were less likely to recognize the process of continental drift that were Americans. Using a threshold of six correct, 37 percent of Europeans and 28 percent of Americans were classified as having a minimally acceptable scientific and technical vocabulary.

The measure of the understanding of scientific thinking, or the process of scientific study, is somewhat more complex. In the United States studies over the last decade, this

dimension has been measured by the combination of a question concerning the meaning of scientific study and a question about the scientific or non-scientific basis of astrology. In these US studies, each respondent is asked to assess their own level of understanding of the basis of a scientific study and those respondents who indicate that they have a "clear understanding" or a "general sense" of it are asked to describe in their own words "what it means to study something scientifically." These open-ended responses are then coded into a set of categories, with those responses that include theory creation, theory or hypothesis testing, experimentation, or even the careful comparative study of things, are classified as correct. Those respondents who were able to define the meaning of scientific study and who recognized astrology as being not at all scientific are classified as having a minimal level of understanding of the process of scientific study. In the 1988 US study, approximately 12 percent of Americans qualified as having this minimal level of understanding.

TABLE 1 : INDEX OF SCIENTIFIC AND TECHNICAL VOCABULARY

	EC 1989	US 1988
. The centre of the earth is very hot (true)	85 %	80 %
. The oxygen we breathe comes from plants (true)	81	81
. Lasers work by focusing sound waves (false)	37	36
. Electrons are smaller than atoms (true)	41	43
. The continents are moving slowly about on the surface of the earth (true)	69	--
. The continents on which we live have been moving their location for millions of years and will continue to move in the future (true)	--	80
. The earliest humans lived at the same time as the dinosaurs (false)	47	37
. The Earth goes around the Sun once a year (composite)	53	45
. The human beings of today are descended from earlier species of animals (true)	62	--
. Human beings, as we know them today, developed from earlier species of animals (true)	--	46
. Percent with six or more correct responses	37	28

The 1989 European Community study included the same set of items, as well as some additional items that had been used in Durant's 1988 UK study. The open-ended European responses have not been coded to date, thus it is not possible to use the same identical procedure employed in the US studies. It was possible, however, to develop a measure that allows, in first approximation, for comparison. Nevertheless, it is felt that to take account of the cultural variety in Europe, the analysis of literacy needs further study.

An examination of the EC data indicated that European respondents were more conservative in their estimates of their own knowledge about scientific study than American respondents and that the correlations between the self-classification of understanding and other knowledge measures was relatively high. Taking these self-reports as a starting point, all EC respondents who reported that they had a clear or general understanding of the meaning of scientific study were included in the potential pool, which included nearly 60 percent of European respondents (see Table 2).

TABLE 2: PUBLIC UNDERSTANDING OF THE PROCESS OF SCIENTIFIC STUDY

	EC 1989	US 1988
Some news stories talk about the results of a scientific study. When you read or hear the term "scientific study", you have ...		
... a clear understanding of what it means	13 %	32 %
... a general sense of what it means	47	49
... little understanding of what it means	29	19
... no answer	11	<1
Would you say that astrology is ...		
... very scientific	14	6
... sort of scientific	41	31
... not at all scientific	32	60
... no answer	13	3
Suppose a drug used to treat high blood pressure is suspected of having no effect. There are three different ways scientists might use to investigate the problem. Which one do you think scientists would be more likely to use ?		
. Talk to those patients that have used the drug to get their opinion	19	--
. Use their own knowledge of medicine to decide how good the drug is	28	--
. Give the drug to some patients but not to ohers, then compare the results for each group	42	--
. No answer	11	--
Suppose the metal of which a particular machine is made is suspected of being responsible for repeated breakage of the machine. There are three different ways scientists might use to investigate this problem. Which one do you think scientists would be more likely to use ?		
. Talk to the machine operators and get their opinion	19	--
. Use their own scientific knowledge to decide how good the alloy is	40	--
. Make machines of different metals, then compare what happens to each one	29	--
. No answer	12	--

Two questions were used as a check against this self-assessment. First, the same astrology question used in the US studies was employed, requiring respondents to indicate that astrology is not at all scientific. Thirty-two percent of Europeans agreed that astrology is not at all scientific. Second, the 1989 study included two versions of Durant's item asking how scientists would solve a medical and a metallurgy problem. Thirty-six percent of European respondents specified the experimental solution. To be classified as having a minimal understanding of the process of scientific study, a European respondent had to report that he or she had at least a "general sense" of the meaning of scientific study, be able to recognize astrology as not scientific, and be able to specify an experimental approach to the problem solving question. Using Miller's approach, nine percent of all European respondents were classified as having a minimally acceptable level of understanding of the process of scientific study.

A comparable study conducted in the United Kingdom in 1988 provided a check on this procedure. The UK study included the same items previously used in the US studies and the study directors collaborated in the coding of the open-ended items. Thus, it is possible to compare both the US open-ended coding approach and the comparable measure approach described above using these two studies of the UK. The results indicated that the open-ended coding approach (including the astrology check) produced

an estimate that 10.4 percent of British adults had a minimally acceptable level of understanding of the process of scientific study, and the comparable estimation procedure outlined above produced an estimate of 13 percent for British adults. This comparison suggests that the comparable measure may be slightly higher than a coding of the open-ended responses would have produced, but the results are sufficiently close to allow the use of the comparable measure in the construction of an estimate of scientific literacy.

The third dimension of the scientific literacy measure concerns the level of awareness of the impact of science and technology on our lives and our society. This measure is based on four identical items asked in both the 1989 European Community study and the 1988 US study (see Table 3).

TABLE 3 : PUBLIC UNDERSTANDING OF THE IMPACT OF SCIENCE AND TECHNOLOGY

	EC 1989	US 1988
. Antibiotics kill viruses as well as bacteria (false)	24 %	26 %
. Radioactive milk can be made safe by boiling it (false)	65	64
. All radioactivity is man-made (false)	57	65
. Correct interpretation of the meaning of one in four	65	57
Percent with three or more correct responses	42	41
N =	11.677	2.041

These items were selected to reflect the kinds of interactions most individuals have with science and technology as consumers, patients, and citizens. The level of public understanding of the impact of science and technology is nearly identical in the European Community and the United States. Approximately 40 percent of both groups were classified as having a minimally acceptable level of understanding of the impact of science and technology.

The three indices described above are the basis for an estimate of scientific literacy in the European Community and the United States. Using this approach, approximately 4.4 percent of Europeans and 6.3 percent of Americans qualify as scientifically literate.

It should be noted, that these figures, based on a series of questions that are defined to test whether the respondent meets Miller's general criteria outlined on p. 3, concern what might be called "steady state" scientific literacy. For specific events, however, both the extent of the vocabulary and the awareness of the influence on daily life are higher as a consequence of the coverage in the media. Therefore, "event-related" scientific literacy may well be higher than "steady state" scientific literacy, which has important implications for the interpretation of the role of scientific literacy data in the public debate.

Public Interest in Science and Technology

A second focus of the 1989 study was the level of public interest in scientific and technological news and issues. Two types of questions were asked to evaluate the attention paid by the European public to scientific news and issues. The first series of questions concerned interest in scientific and non-scientific news issues and the second how well informed the respondent considered he or she was about these subjects.

These results show that 40 percent of Europeans were very interested in new medical discoveries and that approximately a third of Europeans were very interested in new scientific discoveries and new inventions and technologies (see Table 4). The level of interest in the three medical and scientific issues exceeded public interest in sports, films, and politics. Given the marketplace for the individual's time and attention, these results suggest that scientific and technological issues are of considerable interest to the public.

TABLE 4 : INTEREST IN SELECTED ISSUES AND AREAS, 1989

	Very interested	Moderately interested	Not at all interested	No answer
New medical discoveries	41 %	43 %	15 %	1 %
New scientific discoveries	35	43	21	1
New inventions and technologies	32	45	22	1
Sport news	25	36	38	1
Politics	26	48	25	1
New films	20	42	37	1

Question : *Let us talk about those issues in the news which interest you. For each issue I read out, tell me if you are very interested, moderately interested, or not at all interested in it.*

In comparison to a similar 1988 study in the United States, American respondents were significantly more interested in new medical discoveries than European Community respondents (see Table 5). Americans were slightly more interested in new scientific discoveries and the use of new inventions and technologies than Europeans, but the level of interest in some European countries exceeded the level of American interest.

TABLE 5 : INTEREST IN SELECTED ISSUES AND AREAS, BY COUNTRY, 1989

Country	New Medical discoveries	New Scientific Discoveries	New Inventions	Politics	Sports	Films
France	61 %	52 %	48 %	23 %	25 %	28 %
Netherlands	59	45	46	34	34	21
Italy	46	39	34	18	22	18
United Kingdom	42	36	37	22	24	21
Luxembourg	41	42	37	35	32	19
Belgium	35	28	28	20	29	30
Ireland	32	28	29	16	35	23
Germany	32	24	19	44	26	15
Denmark	30	28	28	31	28	18
Greece	27	23	20	40	25	18
Portugal	25	21	20	14	27	19
Spain	20	22	22	13	22	19
EC (1989)	41	35	32	26	25	20
US (1988)	72	43	40	--	--	--

Cell entries are percent "very interested"

As has been noted in previous studies of the public understanding of science and technology, fewer citizens feel that they are well informed about scientific and technical

topics than other areas of the news and the level of self-perceived knowledgeability is lower than the reported levels of interest (see Table 6). For example, about 20 percent of Europeans indicated that they were well informed about political issues and sports news, but about 12 percent thought that they were well informed about new scientific discoveries or the use of new inventions and technologies.

Significantly more Americans felt well informed about new medical discoveries than Europeans, but the level of self-perceived knowledgeability about new scientific discoveries and the use of new inventions and technologies was essentially the same -- about 12 to 14 percent. Again, the proportion of respondents feeling well informed about science and technology was higher in some European countries than the United States and lower in others.

TABLE 6 : SELF-REPORTED LEVEL OF INFORMATION ABOUT SELECTED ISSUES, 1989

	Very w.	Moder.well	Poorly	No answer
Sport news	21 %	41 %	37 %	1 %
Politics	19	57	23	1
New medical discoveries	14	58	26	2
New films	14	43	41	2
New inventions and technologies	12	54	32	2
New scientific discoveries	12	54	32	2

Question: *I would like you to tell me for each if you are very well informed, moderately well informed or poorly informed about it.*

TABLE 7 :
SELF-REPORTED INFORMATION LEVEL ABOUT SELECTED ISSUES, BY COUNTRY, 1989

Country	New Medical discoveries	New Scientific Discoveries	New Inventions	Politics	Sports	Films
Italy	23 %	18 %	16 %	13 %	19 %	12 %
France	22	18	17	23	17	19
Netherlands	20	13	16	23	28	13
Belgium	13	12	12	16	23	19
Luxembourg	13	11	12	24	23	12
United Kingdom	11	10	11	17	21	18
Denmark	11	9	11	25	28	13
Germany	10	9	10	27	24	11
Ireland	9	9	10	16	31	15
Greece	6	5	5	26	19	7
Spain	6	7	7	9	17	13
Portugal	6	5	5	9	20	8
EC (1989)	14	12	12	19	21	14
US (1988)	22	14	13	--	--	--

Cell entries are percent reporting that they are very well informed.

The Attentive Public for Science and Technology

Citizens in every modern nation face a wide array of public policy issue information and disputes in the news. Given the complexity of these issues, it is not possible for most citizens to maintain a high level of interest and knowledge about very many issues at any given point in time. This process is known as issue specialization.

In the 1989 European Community study, it was possible to identify those citizens who reported a high level of interest in new scientific discoveries and the use of new inventions and technologies, who thought that they were well informed about those issues, and who reported a pattern of regular information acquisition about current news. Citizens with a high level of interest and a sense of being well informed and a pattern of regular information consumption are referred to as attentive to science and technology issues[6]. Collectively, they are referred to as the attentive public for science and technology.

An attentive public can play an important role in the formulation of public policy in any given policy area : it is the attentive public that reads current news reports, stays informed about the issues, and is likely to be ready to respond when there is a dispute over a public policy issue. There is no evidence that the attentive public is the origin of new policy initiatives, but it is the segment of the public that responds to policy initiatives from science policy leaders or governments.

Using the measure of attentiveness constructed by Miller in previous studies in the United States over the last decade, the 1989 results indicate that about 19 percent of Europeans are attentive to science and technology policy (see Table 8). This is essentially that same level of attentiveness found in the United States in a series of studies since 1979.

To date, all of the research conducted on the role of the attentive public for science and technology has focused on the United States. It is expected that the role of the attentive public for science and technology may be somewhat different in parliamentary systems like those found in the EC than what has been found in the US separation of powers system.

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[6] In the calculation of attentiveness to science and technology, two separate attitude objects are used. Respondents are asked about their level of interest in and how well informed they are about "new scientific discoveries" and "new inventions and technologies." If a respondent reports that he or she is very interested in and very well informed about either or both of these issues and indicates a regular pattern of newspaper or magazine readership, then that respondent is classified as attentive to science and technology. In addition, those respondents who report that they are very interested in both new scientific discoveries and new inventions and technologies, who classify themselves as moderately well informed on both issues, and who are regular readers of newspapers or magazines are also classified as attentive to science and technology.

TABLE 8 :
SIZE OF THE ATTENTIVE AND INTERESTED PUBLICS FOR SCIENCE AND TECHNOLOGY IN THE EUROPEAN COMMUNITY (1989) AND THE UNITED STATES (1988)

	Attentive Public	Interested Public	Residual Public	N
France	31 %	21 %	48 %	1004
Netherlands	29	22	49	1025
Luxembourg	29	15	56	303
United Kingdom	23	17	60	1271
Denmark	20	12	68	1013
Ireland	18	12	70	1006
Italy	16	19	65	1022
Belgium	14	16	70	1000
Germany	13	11	76	1024
Spain	13	11	76	1001
Greece	12	10	78	1000
Portugal	8	12	80	1000
EC (1989)	19	16	65	11677
US (1988)	21	23	56	2041

General Attitudes toward Science and Technology

A third issue addressed in the survey concerned attitudes toward science and technology, see table 9.

The first line of thought concerned the social usefulness of scientific and technical activity. The second line of thought put to the respondents concerned the desire for scientific knowledge. The third type of question put in the survey concerned living with changes in science and technology, as perceived by the pace of change imposed by scientific and technological development, and the links between science and religion.

If the people who "strongly agree" are grouped together with those who "agree to some extent", it can be seen that a majority agree that basic research should be supported, that science makes our lives easier, that science makes our way of life change too fast, and that the majority doubt whether automation and computers will create more jobs than they will eliminate. The technique used has made it possible to make quite a reliable, valid assessment of attitudes to science : the positive and negative opinions on science were alternated so as to oblige the respondent to change his viewpoint, and analysis of the answers given shows that nearly all of the people questioned (99 %) varied their replies according to the opinions on science put to them.

TABLE 9 : GENERAL ATTITUDES TOWARD SCIENCE AND TECHNOLOGY, 1989

	A %	B %	C %	D %	E %	? %
Science and technology are making our lives healthier, easier and more comfortable	25	48	14	7	2	4
On balance, computers and factory automation will create more jobs than they will eliminate	7	17	17	30	22	7
We depend too much on science and not enough on faith	18	28	20	16	11	7
Even if it brings no immediate benefits, scientific research which advances the frontiers of knowledge should be supported by the government	36	38	13	5	2	6
Science makes our way of life change too fast	24	34	16	15	6	5
Scientists can be trusted to make the right decisions	9	25	24	23	12	7
It is not important for me to know about science in my daily life	13	24	16	24	19	4
The benefits of science are greater than any harmful effects	14	32	26	14	6	8

Question: *Now I would like to read to you some statements; for each statement, would you please tell me how strongly you agree or disagree.*

(Respondent was shown a card with the following choices: strongly agree (A), agree to some extent(B), neither agree nor disagree(C), disagree to some extent(D), strongly disagree(E), don't know (?)).

The attitudes of the European general public to science and technology seem to vary. The power and the positive effects of scientific activity are clearly recognized, but at the same time the general public tends to feel that scientific activity is not controlled and, in the view of a small minority, that it is to the detriment of spiritual aspirations. Even if the drawing of hasty conclusions from such very general trends should be avoided, the set of opinions expressed by the European general public in the survey seems to be in favor of careful management of the development of scientific and technological knowledge.

TABLE 10 :

GENERAL ATTITUDES TOWARD SCIENCE AND TECHNOLOGY, BY COUNTRY

A. Even if it brings no immediate benefits, scientific research which advances the frontiers of knowledge should be supported by the government.
B. Science and technology are making our lives healthier, easier and more comfortable
C. Science makes our way of life change too fast
D. The benefits of science are greater than any harmful effects
E. We depend too much on science and not enough on faith
F. It is not important for me to know about science in my daily life
G. Scientists can be trusted to make the right decisions
H. On balance, computers and factory automation will create more jobs than they will eliminate

Country		A	B	C	D	E	F	G	H	N
France	TP	91	76	58	57	45	36	42	19	1004
	AP	95	84	55	59	45	22	41	21	307
United Kingdom	TP	82	76	51	42	44	29	24	28	1271
	AP	91	86	47	52	38	16	28	39	284
Luxembourg	TP	78	76	63	41	46	27	31	23	303
	AP	85	82	60	48	53	25	28	34	87
Netherlands	TP	78	75	59	30	42	38	23	26	1025
	AP	85	81	60	26	38	27	21	30	301
Italy	TP	76	71	65	49	54	37	41	23	1022
	AP	87	79	63	55	59	18	47	24	164
Ireland	TP	74	70	54	48	45	35	28	22	1006
	AP	90	84	56	53	35	24	30	25	179
Greece	TP	73	84	75	57	51	45	57	36	1000
	AP	89	86	87	63	62	34	64	39	119
Denmark	TP	72	68	58	40	38	34	16	29	1013
	AP	85	80	53	48	35	21	19	41	198
Spain	TP	72	67	69	57	57	46	38	19	1001
	AP	83	77	76	61	61	26	36	21	125
Belgium	TP	70	69	53	42	35	41	39	28	1000
	AP	91	79	56	56	35	29	48	27	140
Germany	TP	53	74	53	35	38	36	29	24	1024
	AP	79	83	46	57	29	21	26	38	135
Portugal	TP	49	60	51	42	39	33	39	26	1000
	AP	79	88	74	65	53	26	53	36	77
EC (1989)	TP	74	73	58	46	46	37	34	24	11677
	AP	88	83	56	52	44	21	35	29	2203
US (1988)	TP	81	85	40	76	51	14	-	40	2041
	AP	87	92	29	82	43	10	--	43	437

TP : Total Public
AP : Attentive public

Cell entries are percentage of respondents indicating 'agreement to some extent' or 'strong agreement'

A comparison with public attitudes in the United States in 1988 reveals a similar attitude structure. Overall, a higher percentage of Americans thought that science and technology were improving the quality of their lives and were supportive of government funding of basic research than Europeans. When asked about the balance of benefits and harms from science, 76 percent of Americans concluded that the benefits of science had been

greater than it harms, but only 46 percent of all Europeans reached the same conclusion (see Table 10).

Americans are significantly more optimistic about the long-term impact of computers and automation on employment than Europeans. Forty percent of Americans agreed that "computers and factory automation will create more jobs than they will eliminate," but only 24 percent of Europeans agreed.

There is also a significant difference between Americans and Europeans in the degree to which they see science as influencing their daily lives. When asked to agree or disagree with a statement that "it is not important for me to know about science in my daily life", only 14 percent of Americans agreed with that view while 37 percent of Europeans concurred with the statement.

On balance, it appears that solid majorities of Europeans and Americans hold positive views about the general effect of science and technology on their standards of living and about the need to fund basic research, but that a higher proportion of Americans hold positive views of the likely impact of automation on employment and think that scientific knowledge plays an important role in their daily lives and work.

II. IMAGE OF, KNOWLEDGE ABOUT AND VIEWS ON EUROPEAN RESEARCH

The Image of European research

This is first of all perceived by comparing Europe with the United States (and Japan) in terms of three criteria: scientific discoveries, technology and industry and, lastly, technological advances applied in daily life.

Above and beyond the overall figures, large differences can be seen from one country to another. These results to some extent reflect the scale of the research embarked upon in the various Member States of the European Community.

TABLE 11 : VIEWS ON EUROPE WITH RESPECT TO USA AND JAPAN

		Europe/USA	Europe/Japan
Scientific discoveries			
Europe ...	more advanced	13 %	27 %
	less advanced	46	41
	the same level	29	18
	no answer	12	14
Technology and industry			
Europe ...	more advanced	15 %	13 %
	less advanced	42	61
	the same level	29	13
	no answer	14	13
Technological advances applied in everyday life			
Europe ...	more advanced	13 %	19 %
	less advanced	46	47
	the same level	27	19
	no answer	14	15

Question: *For each of the following fields, could you tell me whether you think Europe is ahead or behind or at the same level as the United States (or Japan respectively) ?*

To make a summary evaluation of the judgments given with regard to the various aspects of European research and development, we have created an indicator by simply counting the number of times each individual refers to Europe in respect of the three criteria, in the comparison with both Japan and the USA. It is therefore from 0 to 6. It may be regarded as an index of confidence in European research as compared with the USA and Japan (see Table 12).

By calculating the average for the public interested in science and the attentive public from this indicator, it can be seen that these groups cannot be described as very confident in European science and technology as compared to the foreign competitors. However, the probability of referring to Europe in comparisons tends to increase for attentive people.

TABLE 12 : INDEX OF CONFIDENCE

Germany	1.45
United Kingdom	1.15
Netherlands	1.09
France	1.07
Luxembourg	0.83
Belgium	0.80
Ireland	0.80
Greece	0.71
Italy	0.73
Denmark	0.62
Portugal	0.58
Spain	0.48

Numerous factors have been suggested to explain the relative weakness of Europe as perceived in the field of science and technology. Four of these were put to the general public for its assessment. On the basis of these four criteria, Europeans always place Europe behind the United States, and, for three of them, behind Japan (see Table 13).

TABLE 13 : AVERAGE RANKING BASED ON THE % OF ANSWERS BY COUNTRY

	Europe	USA	Japan
. Has the best educated scientists	2	1	3
. Spends the most on scientific research	3	1	2
. Is most successful in turning scientific discoveries into useful products	3	2	1
. Is best at coordinating research carried out by different bodies (private industry, universities, research laboratories, etc)	3	1	2

Question: *I am now going to ask you whether in your opinion, Europe, the United States or Japan leads in each of the following fields. If you have no view on a particular field please tell me and we will move on to the following one.*

Knowledge about and Perception of "Europe of Science and Technology"

Several questions related to knowledge about and the perception of the research activities of the European Community. The first aspect concerned knowledge about areas in which the EC is active, see table 14.

The results first of all show that there is a poor level of knowledge about the fields of activity of the European Community. For instance, the average number of "don't knows" is high and the defence sector, which is not the subject of Community programmes, is cited by one-fifth of Europeans as being one of the sectors of activity of the Community, and more than one-third if those who replied "all of these" are added.

These figures can nevertheless be interpreted as being an indication of the percentage of respondents who feel it is likely, or natural, that the Community is active in one area or another.

TABLE 14 : KNOWLEDGE OF EC ACTIVITIES

	Community as a whole
Agriculture	47 %
Energy	20
Science	20
Environment	27
Defense	19
All of these	23
None of these	2
No answer	15
Total	(1)

(1) Total > 100 : Several positive replies possible

Question: *In which of the following areas is the European Community itself active ?*

An examination of the replies from the attentive public indicates that this group is better informed about the activity of the Community in the field of science and technology.

In order to evaluate the awareness about the research programmes of the European Community, only those who knew about the existence of a Community activity in the field of science and technology were then asked to say what they know about the areas of research concerned.

TABLE 15 : KNOWLEDGE OF EC RESEARCH ACTIVITIES

	%
Environment	58
New agricultural techniques	57
Telecommunications	57
New techniques of industrial production	46
Civil nuclear	38
Biotechnology	33
Information technology	30
Robotics	27
Research into the origin and nature of the universe	23
Psychological research	18
No answer	5
Total	(1)

Base 100 = all people who answered 'science' or 'all of these' to the previous question
(1) Total > 100 : several positive replies possible

Question: *In which of the following sectors of scientific research is the European Community itself active ?*

Several arguments can be put forward to explain the large gap between the percentages of positive replies for the various sectors. Among the sectors referred to most, agriculture is a traditional field of Community activity. This probably led a number of people to give a positive reply. Furthermore, environmental issues have recently been the subject of public debate and of Community awareness and information action, i.e. the European Year of the Environment. Lastly, telecommunications have an international ring.

The two sectors cited least, psychology and research into the origin and the nature of the universe, are not the subject of Community research programmes. There is therefore a certain parallel between reality and the perception of the general public.

The breakdown between the various sectors, from those most widely known to those with which Community intervention is least identified, is the same within the attentive public.

A second set of questions concerned the comparison between research at the national level and research at the European level, see table 16.

Compared with research carried out at the national level, research at the European level is perceived to save money and be more effective, with a slight advantage to effectiveness. This suggests there are a large number of respondents for whom the European level constitutes an efficiency factor.

The opinions given for the three other scores were more broadly favourable to European research : it is expected to become more important, it gives rise to more hope with regard to economic growth than research at the national level and a majority of Europeans felt that scientific and technological research at the European level is in the national interest.

TABLE 16 : VIEWS ON EC RESEARCH AS COMPARED TO NATIONAL RESEARCH

Question: *I am going to present you with some opinions on scientific research as it is conducted by the European Community. If you fully agree with the statement on the left hand, please give the score 1. If you fully agree with the statement on the right hand, please give the score 5. The other scores allow you to vary your judgment.*

Compared with research carried out by the individual countries, scientific research conducted at the European level...

	1	2	3	4	5	?	
wastes money	11	13	29	15	15	17	saves money
is less effective	7	13	23	21	20	16	is more effective
will become less en less important	3	5	12	28	39	13	will become more and more important
is unhelpful to economic growth	4	5	18	28	31	13	is very helpful to economic growth
goes against our national interest	6	7	23	23	26	15	goes along with our national interest

Cell entries in percent

Factorial analysis of the replies to these five questions was carried out to identify and then to quantify the significance of any common factors underlying the replies to the various questions. This made it possible to obtain a "factor of confidence" in European research. From a technical viewpoint, this factor is none other than the first main component associated with the five variables studied. In simpler terms, it is a new variable expressed as a weighted average, for each individual, of the figures obtained for the various scores. This structure enables it to be interpreted as a "confidence factor".

By calculating, for each country, the average of the individual differences, a figure is obtained which characterizes its degree of confidence in European research.

Table 17 classifies the twelve Member States on the basis of this new variable. Zero is the European average. The countries with a positive figure have above-average confidence in research carried out at the European level (as opposed to research at the national level).

This classification on the basis of confidence in European research as opposed to confidence in national research does not correspond to the classification of the countries according to their confidence in the scientific and technological strength of Europe as compared with foreign competitors such as the USA and Japan (Table 12).

TABLE 17 : RATES OF CONFIDENCE IN EUROPEAN RESEARCH

Spain	.31
Portugal	.29
Italy	.26
France	.16
Luxembourg	.14
Greece	.11
Netherlands	.08
Ireland	.07
Belgium	.06
Denmark	-.25
United Kingdom	-.29
Germany	-.36

The judgments of the attentive group as to the various advantages of European research do not differ very greatly from those of the population as a whole.

Areas Requiring a Common European Policy

Knowledge about the activities of the European Community in the field of science and technology and the image of European research are the first two aspects of the perception by the general public of European research. A third aspect concerns opinions about the areas in which a common European policy should be developed in view of the further integration of the EC.

Looking at the percentages of the positive replies for the various areas (see Table 18), it can be seen that the question leads to a classification of domains which, if dealt with at the European scale, will contribute most to the completion of the single European market by 1992. In the eyes of the general public, the single market requires European policies in a very wide range of areas.

The high rank of scientific and technological research can undoubtedly be interpreted in terms of the relatively precise perception of the prospects opened up by European activity in this area (see the judgments about research at the European level).

Furthermore, the development of scientific and technological research at the European level will make it easier, for example, to lay down common standards, which themselves will make it possible to widen the markets, and contribute to the completion of the single internal market by 1992. While it is not claimed that the reasoning of the general public

is so specific it would appear that respondents feel that Europe must also be a Europe of science and technology.

TABLE 18 :

(A) AREAS IN WHICH A COMMON EUROPEAN POLICY SHOULD BE DEVELOPED

	Yes	No	No Answer
. Protection of the environment	93 %	3 %	4 %
. Scientific and technological research	84	7	9
. Security, defence	81	11	8
. Cooperation with developing countries	77	12	11
. Relations with countries outside the E.C.(United States,China,Japan)	77	12	11
. Social security	70	19	11
. Culture	67	23	10
. The currency	64	25	11

Question : *Thinking about the single European Market in 1992, do you feel there are areas where a common European policy should be developed ? Please answer yes or no for each of the following areas.*

(B) RESULTS BY COUNTRY

A - Research
B - Protection environment
C - Security, defence
D - Cooperation with developing countries
E - Relations with countries outside the E.C.
F - Social security
G - Culture
H - Currency

Country :	A	B	C	D	E	F	G	H
France	92	95	89	82	85	78	82	82
Italy	87	94	83	79	75	74	75	80
Netherlands	87	98	83	83	85	74	50	61
Luxembourg	84	94	82	72	79	75	68	62
Spain	84	87	73	78	74	73	79	70
United Kingdom	83	93	82	80	78	62	49	42
Germany	81	95	81	72	74	66	66	55
Belgium	80	87	77	64	71	64	63	67
Ireland	80	89	70	84	75	77	59	64
Denmark	76	92	48	66	71	58	43	48
Greece	76	82	67	73	67	74	56	58
Portugal	72	79	75	74	69	71	67	55

III. PROBLEMS AND PROSPECTS OF INTERNATIONAL COMPARISON

The significance of the 1989 Eurobarometer science and technology survey may perhaps be judged from the authorship of the present paper. We are, respectively : a British Professor of Public Understanding of Science; an American Professor and Director of a Public Opinion Laboratory; the director of the organization that carried out the survey for the EC and a staff member of the Directorate General for Science, Research and Development of the Commisison of the EC. The fact that we have cooperated in the planning, the design and the final interpretation of the present survey reflects our common desire to achieve convergence, and hence comparability, in a field of growing international interest.

By working together from the outset, we have succeeded in establishing a core set of questionnaire items common to the 1988 British, the 1988 US and the 1989 Eurobarometer surveys of public perceptions of science. In 1990, this core set of items again featured in another US "Science Indicators" survey, the results of which will be presented by professor Miller at this meeting. The core set covers interest, informedness, understanding and attitudes in relation to science and technology; and it provides what we believe is the first substantial opportunity for systematic multi-national comparative survey studies of public understanding of science.

There are at least three reasons why comparative studies of this kind are important. First, by bringing together researchers from different countries such studies facilitate the refinement of survey methodology in this area. Necessarily, each contributing team is obliged to defend its preferred items and protocols in face of the close scrutiny of colleagues from different intellectual and national traditions. In our experience this is a salutary, if occasionally rather gruelling, experience.

Second, international comparative surveys are important because for the most part survey researchers and policy makers are much more interested in relative than they are in absolute measures. Certainly, it is useful to know that, say, 45% of Dutch people profess to be very interested in new scientific discoveries; but it is much more useful to know that this is significantly higher than the comparable figure for Germany (24 %) and significantly lower than the comparable figure for France (52 %). In general, isolated figures are difficult to interpret for lack of an appropriate context in which to set them. By contrast, a series of comparable figures permits judgements to be made concerning the significance of individual results. In our view, this is one of the chief uses of the results that we have presented in this paper.

The third reason for attaching importance to international comparison is an extension of the second. For the fact is that the possession of comparable data from several different countries allows far more than the mere comparison of raw results. Just as standardised data from a single national sample may be analyzed in terms of the influence of individual-level independent variables (age, social class, etc.), so standardised data from a reasonably large number of national samples may be analyzed in terms of the influence of national-level independent variables (Gross Domestic Product, Level of

industrialisation, etc.). In this way, international comparative surveys greatly extend the range of the hypotheses that may be formulated and tested about the factors that are at work in shaping public perceptions of science. A companion paper to the present study by Bauer, Durant and Evans utilises the 1988 Eurobarometer data set in precisely this way.

These, then, are the principal reasons for attempting international comparative survey research on the public understanding of science. Such research is not, however, without its methodological difficulties. We have already mentioned the considerable challenge that is represented by the task of negotiating a core set of common items for inclusion in comparable survey questionnaires. This challenge is made all the greater by the divergent interests of research groups (and research funding agencies) in different countries, as well as by the considerable investment that individual teams naturally tend to have in their own tried and trusted techniques.

Another methodological difficulty is posed by the use of different languages. Two of us (Durant and Miller) grappled with the problems of translation between English English and American English. Britain and the USA are, as George Bernard Shaw once remarked, two nations divided by a common language; but of course our problems were as nothing compared with the difficulties of arranging for the accurate translation of a single set of questions into no less than 9 different languages for the purpose of the 1989 Eurobarometer study ! Here, of course, we were obliged to rely upon the services of a network of translators working for a network of national survey agencies. In general, we believe these networks were extremely effective. However, some of the subtler questions did pose problems. For example, the Parisian survey agency from whom the research was commissioned reported particular difficulties in the evaluation of open-ended responses according to a standardised coding frame, which forced us to used slightly different methodologies to arrive at approximate comparison of literacy in the EC and in the US. In future studies, we may have to find new ways of establishing clear and consistent protocols for interviewers and encoders.

A final, and potentially the most serious methodological difficulty has to do with sampling techniques. The 1988 British and US national surveys utilised strict probability sampling. (In Britain, for example, national electoral registers were used to identify named individuals according to a strict randomizing procedure). By contrast, the 1989 Eurobarometer survey employed a mixture of sampling methods : in some countries random (Denmark, Luxembourg, Netherlands), in some countries quota sampling (Belgium, France, Italy, United Kingdom, Ireland) and in some countries a method combining the two precedent ones (Germany, Greece, Spain, Portugal). (In Britain, this involved the use of a small number of predetermined sampling points, at which prescribed numbers of interviews with different types of interviewees were then obtained). Probability sampling is generally regarded as the more accurate of these two sampling methods; but unfortunately it is also by far the more expensive of the two to administer.

The 1988 British national survey and the 1989 Eurobarometer data set for Britain provide an excellent opportunity to explore the possible influence of sampling methods upon results. For these two British surveys employed large numbers of identical questions (in the same language !) and relatively large sample sizes (c. 2000 in the 1988 study, and c. 1000 in the 1989 study). Moreover, the two studies were separated in time by only 9 months. This short time interval may, of course, have had some influence on the results; but on the whole such influence is likely to have been quite small.

Comparing the results of the 1988 and 1989 British surveys on a number of comparable items, we find a mixed picture. Differences in self-rated interest and informedness in science, and in attitudes towards science, are only slight; but in the area of knowledge there is a moderately large difference, with significantly higher proportions of the 1989 quota sample answering most questions correctly. (See Table 19). There are several possible explanations for these differences, and some of these are still being actively explored. At this stage, therefore, we shall make just two comments : first, it is possible that the 1989 quota sample may have been biased in favour of scientifically better-informed people and second, this source of bias would be removed in future multinational comparative surveys if they were to employ the same sampling method.

TABLE 19 : BRITISH KNOWLEDGE OF SELECTED SCIENTIFIC TERMS AND CONCEPTS

Per cent correct	UK 1988	EUROBAROMETER 1989
. The centre of the Earth is very hot	86 %	88 %
. The continents are moving slowly about on the surface of the Earth	71	76
. The oxygen we breathe comes from plants	60	76
. The earliest humans lived at the same time as the dinosaurs	46	56
. Lasers work by focusing sound waves	42	51
. Does the Earth go around the Sun or does the Sun go around the Earth ? How long does it take for the Earth to go around the Sun : one day, one month or one year ?	34	45
. Electrons are smaller than atoms	31	38
. Antibiotics kill viruses as well as bacteria	28	40
N =	2009	976

In spite of the difficulties that inevitably attend any international comparative survey study, we believe that the effort involved is extremely worthwhile. Multi-national survey studies of social and political attitudes have been well-established for many years, and they have proved invaluable in comparative analysis of social and political trends. We have joined with other survey researchers in Canada, France, Japan in forming an International Council for the Comparative Study of the Public Understanding of Science and Technology. This Council met last year in London, and again yesterday during this meeting of the AAAS in Washington. A commitment to the establishment of comparability now exists amongst researchers whose work spans more than 15 different countries in Asia, Europe and North America. We invite survey researchers who are working in other countries to join this effort to map public perceptions of science and technology around the world.