EUROBAROMETER

Special Eurobarometer

European Commission

Europeans and Biotechnology in 2005: Patterns and Trends

July 2006

Special Eurobarometer 244b / Wave 64.3

This survey was requested by Directorate General for Research and coordinated by Directorate General Communication

Europeans and Biotechnology in 2005: Patterns and Trends

Final report on Eurobarometer 64.3

A report to the European Commission's Directorate-General for Research

by

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July 2006

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Contents

Summary of key findings

Introduction

This is the sixth in a series of Eurobarometer surveys on biotechnology. The surveys have been conducted in 1991, 1993, 1996, 1999, 2002 and 2005. The survey is based on a representative sample of 25,000 respondents, approximately 1,000 in each EU Member State. Currently, issues such as stem cell research, the co-existence of GM, conventional and organic farming, the use of genetic information, and other innovations such as nanotechnology and pharmacogenetics are under discussion. Furthermore debates about broader issues such as the governance of science and citizen engagement continue. This survey is intended as a contribution to the informed public and policy debate on these and related issues.

Overview

The portrait of European citizens painted by the 2005 survey shows them to be increasingly optimistic about biotechnology, more informed and more trusting of the biotechnology system. The European public is not risk-averse about technological innovations that are seen to promise tangible benefits.

While the majority are willing to delegate responsibility on new technologies to experts, making decisions on the basis on the scientific evidence, a substantial minority would like to see greater weight given to moral and ethical considerations in decision taking about science and technology and to the voices of the public.

There is widespread support for medical (red) and industrial (white) biotechnologies, but general opposition to agricultural (green) biotechnologies in all but a few countries. Europeans are interested in finding out about the risks and benefits associated with stem cell research, a utilitarian approach that informs their generally supportive view of this technology. The lesson for agri-food biotechnology is that unless new crops and products are seen to have consumer benefits, the public will continue to be sceptical.

Looking across public perceptions of a range of technologies, resistance to GM food is the exception rather than the rule. There is no evidence that opposition to GM food is a manifestation of a wider disenchantment with science and technology in general.

Optimism about the contribution of technology to society

Europeans are generally optimistic about the contribution of technology to our way of life. An index of optimism shows a high and stable level for computers and information technology and solar energy from 1991 to 2005. Over the same period the index for biotechnology declined steeply from 1991 to 1999. From 1999 to 2005 the trend reversed, and now biotechnology is back to the same level of optimism seen in 1991. Optimism about nanotechnology has increased since 2002 – the ratio of optimists to pessimists is eight to one. Europeans have become less pessimistic about nuclear power, but the pessimists still outnumber the optimists, even in France.

Nanotechnology, pharmacogenetics and gene therapy
Europeans support the development of nanotechnology, pharmacogenetics and gene therapy. All three technologies are perceived as useful to society and morally acceptable. Neither nanotechnology nor pharmcogenetics are perceived to be risky. While gene therapy is seen as a risk for society, Europeans are prepared to discount this risk as they perceive the technology to be both useful and morally acceptable.

GM food
Overall, a majority of Europeans thinks that GM food should not be encouraged. GM food is seen by them as not being useful, as morally unacceptable and as a risk for society. Looking at a section of the European public – the 'decided' public (approximately 50 per cent) – who have a view on four key questions about GM food, 58 per cent oppose and 42 per cent support. Only in Spain, Portugal, Ireland, Italy, Malta, Czech Republic and Lithuania do the supporters outnumber the opponents.

Purchasing intentions for GM food
There are mixed opinions on the acceptability of buying GM food. The most persuasive reasons relate to health, the reduction of pesticide residues and environmental impacts. Whether GM food is approved by the relevant authorities or is cheaper are not convincing reasons.

Across the EU Member States the percentage of people rejecting five suggested reasons for buying GM food varies from about 5 to 55 per cent. Countries with the highest percentage of rejecters are Austria, Greece, Hungary, Germany and Latvia and with the lowest percentage of rejecters are Malta, Czech Republic, Netherlands, Spain, Belgium and Portugal. Amongst the non-rejecters, it is notable that the mean number of acceptable reasons is relatively high. It appears that once a threshold of minimal acceptability is reached, people are inclined to find a number of the reasons acceptable for buying GM foods.

Industrial (white) biotechnologies
Industrial applications of biotechnology in bio-fuels, bio-plastics and biopharming for pharmaceuticals are widely supported in Europe, with over 70 per cent of respondents supporting incentives to develop bio-fuels and plastics. More people than not say they would pay more for a vehicle that runs on bio-fuels and pay more for bio-plastics. Around six in ten approve of biopharming providing that it is tightly regulated and across the EU countries those approving of biopharming outnumber those who disapprove in all but Austria.

Stem cell research
Providing it is tightly regulated there is considerable support for embryonic stem cell research across Europe, and although people tend to be more supportive of non-embryonic sources of stem cells the difference is relatively small, 59 to 65 per cent respectively. Among the countries in which approval for embryonic stem cell research is highest are Belgium, Sweden, Denmark, Netherlands and

Italy. In countries where approval is low – the Baltic States, Slovenia, Malta, Ireland and Portugal – around one in three say they don't know.

While the belief of a majority of Europeans is that the embryo is human immediately after conception, a belief that is related to views on stem cell research, it is not the decisive factor. Many who believe it also say they approve of stem cell research as long as it is tightly regulated. A broadly similar pattern is seen when looking at levels of commitment to religious practices. The survey shows that the dilemma between moral/ethical versus utilitarian arguments divides the European public. Of these two positions Europeans lean towards the utilitarian view; the promised benefits for health and the alleviation of diseases tend to outweigh possible moral objections. However, with support contingent on benefits, the question is raised as to whether the projected benefits of stem cell research, widely reported in the mass media, are realistic or hyperbole; for if it is the latter support is likely to evaporate.

What do people want to know about stem cell research?
When asked – if there was a referendum on stem cell research, what information would you like to hear about? – Europeans generally do not consider it important to be informed about scientific details, perhaps because they are content to leave these to the experts. What they want to know about are the societal consequences of stem cell research – the risks and benefits – and whether regulations and ethical oversight are sufficient.

Governance of science and technology
Given a choice between, firstly, decisions making based on scientific evidence or on moral and ethical criteria, and secondly, decisions made on expert evidence or reflecting the views of the public, the majority of Europeans (six in ten) opt for the principle of *scientific delegation* (experts and scientific evidence). Nearly one in five opt for *moral delegation* (experts and moral reasoning), one in six *moral deliberation* (the public and moral reasoning) and one in ten *scientific deliberation* (the public and scientific evidence). Of the four principles of governance, *scientific delegation* is associated with higher levels of optimism about technology and support for nanotechnology and GM food. The principle of *moral delegation* is associated with lower levels of optimism and lower support for specific technologies. To build further confidence in science policy it would seem prudent to ensure that moral and ethical considerations and the public voice(s) are seen to inform discussions and decisions.

Trust in actors involved in biotechnology
The 2005 survey data do not support the claim that there is a crisis of trust in actors involved in biotechnology in Europe. Trust in university and industry scientists, and in industry itself show substantial improvements since 1999. The European Union is more trusted than respondents' national government in the regulation of biotechnology and on the reporting of biotechnology, newspapers and magazines are trusted more than television.

Uses of genetic information

The European public is supportive, but not overwhelmingly supportive, of the use of genetic data for personal medical diagnosis and for gene banks for research into diseases. 58 per cent say they would allow their genetic data to be banked for research purposes, while 36 per cent say they would not. Forensic uses attract about the same level of support as medical research. Access to genetic information by government agencies and for commercial insurance is widely seen as unacceptable. Support for genetic data banks cannot be taken for granted. While 70 per cent or more are in support in Sweden, Finland, Denmark, and Netherlands – perhaps evidencing the communitarian ethic – support is only around 40 per cent in Germany, Greece and Austria and the public in some other countries is evenly divided on the issue.

Modes of engagement in science and technology

Europeans are more knowledgeable about biotechnology and genetics than in 2002. A majority say they are 'often' or 'sometimes' 'interested in science and technology' and 'keep up to date on what is going on in science and technology'. 71 per cent of the European public 'definitely would' or 'probably would' read articles or watch TV programmes on biotechnology, 33 per cent would take part in public discussions or hearings.

Four modes of engagement with biotechnology are identified – the 'active' (10 per cent), 'attentive' (15 per cent), 'spectator' (35 per cent) and 'unengaged' (40 per cent) European. The 'active' European has heard and talked about biotechnology, has searched the internet for information about it and has probably attended a public meeting concerning biotechnology; for the 'unengaged' European, the issue is not on the radar screen. Compared to the other two modes of engagement the 'attentive' and 'active' Europeans are more optimistic about the contribution of technology to society and more supportive of technologies. A feature that distinguishes the 'active' from the 'attentive' European is that the former is more sensitive to risk.

Young people and science

Is the younger generation of Europeans turning against science and technology? The snapshot from the Eurobarometer would suggest not. The age group from 15-25 is no less optimistic about technological innovation, no less willing to support nanotechnology, gene therapy, pharmacogenetics and GM food, and just as interested in science and technology as are older people. On all these opinions about science and technology it is the over 65s that are either more critical or not prepared to express an opinion.

Younger people are more likely to say they would buy GM food and less likely to hold menacing images of GM food than older people. However, younger people are less engaged in politics, and less likely to worry about the links between diet and health. This is not good news for the emerging problem of obesity.

Women and science

The findings from the Eurobarometer suggest that we must be cautious about generalisations on gender differences. On five of the eight technologies, women are almost as optimistic as men that these technologies will improve our way of life. While men are generally more knowledgeable about biology and genetics, women out-score men on questions around pregnancy – an issue of direct concern to them. On approval for nanotechnology, gene therapy and pharmacogenetics differences between women and men are not pronounced and amongst the more educated women the gender difference is much smaller. Women with higher education are less likely to show an 'attentive' or an 'active' interest in biotechnology. Is this more likely to be a consequence of the traditional division of labour in European households rather than an intrinsic lack of interest among women?

Science Culture in the New Member States

Have the ten new Member States changed the scientific culture of the European Union? The answer is 'probably not'. Collectively the ten new countries are just about as heterogeneous as are the old EU15 countries, judged by this set of indicators of science culture. As many of the ten are in the industrial stage of development, they share some common features that were also seen in other 'new entrants' to the EU in the past. As such, the New EU10 are somewhat different to the EU15 countries in 2005. First, by comparison to EU15, science has not achieved much penetration in public awareness in the New Accession States. Second, the publics in these countries are relatively more optimistic about the contribution of technology to society, and are just as supportive of medical, industrial and agricultural biotechnologies. They also have greater trust in actors and institutions involved in science and technology. But, as has been seen in other EU Member States, such views can be subject to dramatic changes.

Transatlantic comparisons

It is invalid to claim that European public opinion is a constraint to technological innovation and contributes to the technological gap between the US and Europe. With the exception of nuclear energy, Europeans are more or less as optimistic as people in the US and Canada about computers and IT, biotechnology and nanotechnology. One exception is GM food for which Europeans and Canadians have rather similar views, while people in the US see it as much more beneficial and less risky. Europe's position is strikingly different on nanotechnology. In comparison to people in the US and Canada, Europeans see nanotechnology as more useful and have greater confidence in its regulation.

1. Introduction

Over the last ten years there have been dramatic developments in basic research in the life sciences and in applications of biotechnology. Among the most notable developments are the creation of genetically modified foods, the cloning of Dolly the sheep, the sequencing of the human genome, and developments in stem cell research. All these innovations have been widely discussed in policy and mass media arenas throughout Europe, and in these discussions, competing visions of the future can be heard. On the one hand is the promise of science and technology to deliver benefits in health, agriculture and foods and in industrial production. On the other hand is the concern that the scientifically possible is not always socially, ethically or environmentally desirable.

The public are often witnesses to these debates; some are active participants. But not everyone has the time, the inclination, or indeed the opportunity to voice his or her views. And here the Eurobarometer survey plays a role. Systematic survey research represents public voices – for the European public does not speak with one voice – to policy makers, representatives of industry, journalists, civil society groups, scientists and social scientists – and even to the public themselves.

Eurobarometer 64.3 on Biotechnology is the sixth in the series of surveys of public perceptions of biotechnology. The series started in 1991 (Eurobarometer 35.1)[1] in the twelve Member States of the European Community. It was followed by the second in 1993 (Eurobarometer 39.1)[2]. In 1996, the third in the series (Eurobarometer 46.1)[3] covered the fifteen Member States of the expanded European Union. The fourth in the series (Eurobarometer 52.1)[4] was conducted in 1999 and the fifth in 2002 (Eurobarometer 58.0)[5]. The new survey in 2005 covers the now 25 Member States of the European Union.

The survey questionnaire for EB 64.3 includes key trend questions, designed to assess the stability or change in aspects of public perceptions over the last ten years or more. It also includes new questions that capture opinions and attitudes to emerging issues in the field of biotechnology. And as in 2002 there are questions on nanotechnology, in part because nanotechnology has been heralded as the next strategic technology, but also on account of its links with biotechnology, as seen in the emergence of the so-called converging technologies.

Within the time frame of 1991-2005 the Eurobarometer surveys on biotechnology are one of the most systematic resources monitoring patterns and trends in public perceptions. The data from these surveys has informed official reports, been widely quoted in the media and used in many academic articles and books. Some of the specific questions in the surveys have also been used in studies around the world, for example the USA, Canada, Japan and Brazil to name but a few.

Some wonder whether information based on a survey of only 1,000 persons in each European country can provide reliable information. Surely a larger number would be necessary? While it may seem counter-intuitive, statistical theory shows that with a systematic sample it is possible to calculate the possible error attached to any generalisation from a sample to the wider population. Thus, in survey samples of 1,000 respondents where 50 per cent think X and 50 per cent think Y, we can be 95 per cent confident that the true contrast in the population is captured within the interval 50 per cent +/- 3.1 per cent, that is between 46.9 and 53.1 per cent (95 per cent confidence limits). And if the sample were to be increased from 1,000 to even 10,000 the sampling error would only decrease to +/-1.0 per cent. Thus, where very precise figures are not needed, for the Eurobarometer is not a referendum, there is no reason to opt for larger samples with all the additional costs that would entail.

Now some claim, and rightly so, that survey research is an imperfect instrument. Isn’t there more to public perceptions than the answers to a number of predetermined questions? We take the view that surveys are useful as general indicators of the contours of public perceptions, particularly when comparative and time series data are available. Surveys provide low-resolution portraits of the broad panorama. But they are clearly not ideal when it comes to the very fine detail – the shades of light and colour revealed only through close inspection. For this, other types of social research can provide the complementary perspective.

Some argue that the Eurobarometers on biotechnology, and indeed other survey research on public views of science, sustain the infamous 'information deficit model' of the public, which proposes that any negative attitudes to science and technology are the result of public ignorance. This 'straw man' critique is at variance with our eclectic approach, which draws on concepts and ideas from social psychology, sociology and political science. In doing so, we treat the relationship between attitudes and knowledge as an empirical matter, to be examined alongside many other interesting issues.

However, the critique of surveys illustrates some important points. Surveys represent the world in particular ways. Depending on the perspective adopted, the representations will differ. Moreover, survey results do not have a single, obvious and unequivocal meaning. Whether the glass is half full or half empty is a matter of personal preference. In this report we provide our interpretation. But because other interpretations are possible, we include the basic data in the appendix.

The report is divided into three sections. The first provides an analytic description of Europeans' perceptions of biotechnology in 2005, with, where possible, time series comparative data. This is followed by two annexes: the questionnaire, and basic descriptive statistics for each question by country, with a technical note including details of survey sampling and weighting.

2. Technological optimism & pessimism

In the Eurobarometer survey respondents were asked whether particular technologies 'will improve our way of life in the 20 years', 'will have no effect', or 'will deteriorate things', and a 'don't know' response was accepted but not offered by the interviewer. This question has been asked since 1991 and it provides both an indicator of general sentiment towards technology and innovation, and places views about biotechnology in the context of other technologies. Over the six waves of the Eurobarometer on biotechnology some of the target technologies have been maintained, others have been dropped and over the period new technologies introduced to keep abreast of new developments.

In 2005 respondents were asked about seven technologies – the first time the technology was used in the time series is indicated in brackets. The target technologies were computers and information technology (from 1991), biotechnology (from 1991), space exploration (from 1991), solar energy (from 1993), nuclear energy (from 1999), mobile phones (from 2002), nanotechnology (from 2002) and wind energy (new in 2005). Since 1991, a split ballot was used for biotechnology, with half the sample asked about 'biotechnology' and the other half asked about 'genetic engineering'.

Figure 1: Optimism and pessimism for eight technologies in 2005

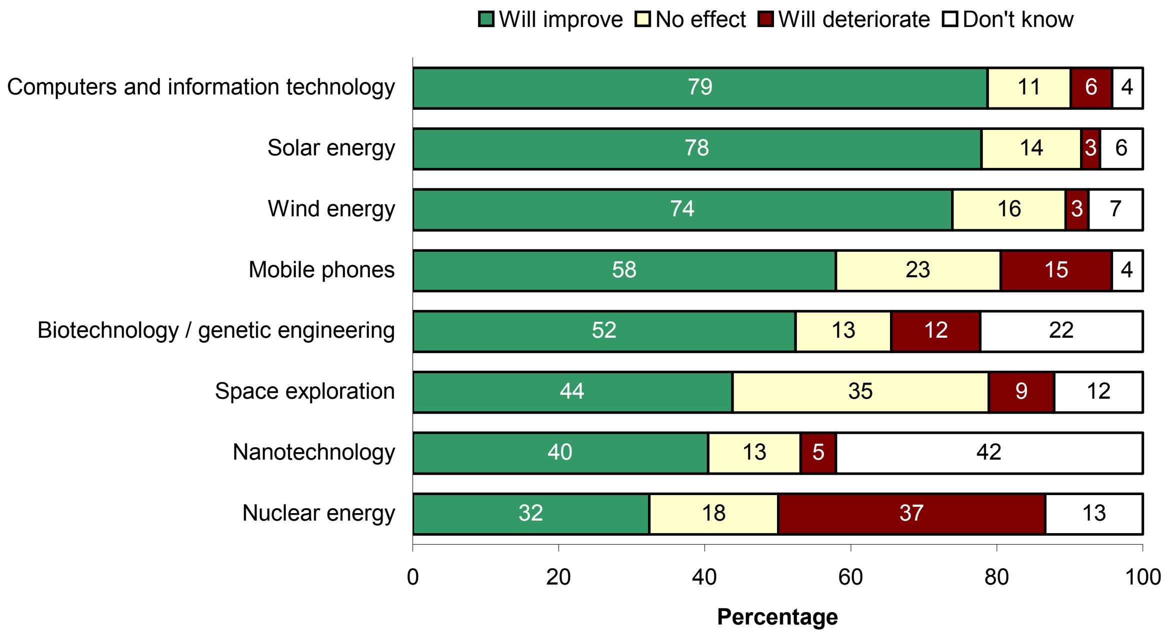


Figure 1 shows that a majority of Europeans are optimistic about biotechnology and genetic engineering. In comparison to biotechnology (combining responses for biotechnology and genetic engineering), they are more optimistic about computers and information technology, solar energy, wind energy and mobile phones, but less optimistic about space exploration, nanotechnology and nuclear energy.

The contrast between the four so-called strategic technologies of the post-World War 2 years is strikingly varied. For modern biotechnology, 52 per cent are optimistic and 12 per cent are pessimistic. The comparable figures for nuclear power are 32 per cent optimistic and 37 per cent pessimistic; for computers 79 per cent optimistic and 6 per cent pessimistic, and for the latest innovation, nanotechnology, 40 per cent are optimistic and 5 per cent pessimistic.

Not surprisingly on account of its novelty, the percentage of 'don't know' responses for nanotechnology is above 40 per cent. But that biotechnology, even after (perhaps even because of) many years of controversy, still elicits a 'don't know' response from one in five, suggests that many people have still to make up their minds about its prospects.

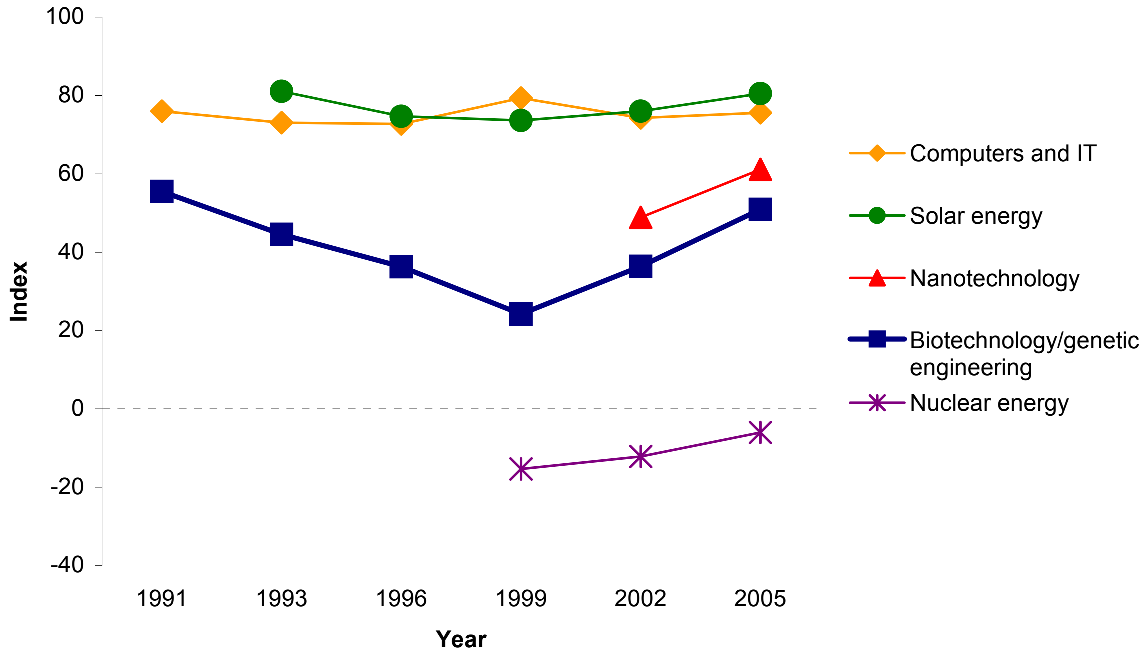
After years in the doldrums, nuclear power has been heralded of late as one of the solutions to global warming and energy security; it seems that the European public has yet to be convinced.

The terms 'biotechnology' and 'genetic engineering', as in previous years, appear to have different connotations for the public. 8 per cent more Europeans see 'biotechnology' as likely to improve their way of life in the future than those asked the same question about 'genetic engineering'. In 1999 the difference was 8 per cent, in 2002 it was 5 per cent. The more positive connotation of the term 'bio', perhaps a result of the association with healthy and natural things, contrasting with 'engineering,' with its connotations of manipulating or tampering, holds across much of Europe with the exception of Spain, Italy and Malta. Perhaps most striking is the 'lead' of biotechnology over genetic engineering in some countries: it is more than 20 per cent in Belgium, Denmark, Germany, Finland and Austria.

2.1 Trends in optimism

To assess the changes in optimism and pessimism over time (1991 to 2005) we use a summary index. For this we subtract the percentage of pessimists from the percentage of optimists and divide this by the combined percentage of optimists, pessimists and those who say the technology will have no effect. In excluding the 'don't know' responses, this index is based on only those respondents who expressed an opinion. A positive score reflects a majority of optimists over pessimists, a negative score a majority of pessimists over optimists and a score around zero more or less equal percentages of the two.
This index has the following merits. Firstly it is an economical way of presenting the time series and country comparative data; secondly with substantial differences in the 'don't know' responses across countries, the raw scores can be misleading; and thirdly it weights the balance of optimism and pessimism in relation to all the respondents who had expressed an opinion on the question.

Figure 2: Index of optimism about five technologies



The time series of the index of optimism shows some interesting trends. Levels of optimism about computers and information technology and solar energy have been high and stable over the period. By contrast, optimism in biotechnology, which declined steadily over the period 1991-1999, rose appreciably between 1999-2002, and this upward trend has been maintained. It is now, more or less, at the same level as in 1991. This is certainly not a result of the ten new Member States – a comparison for 2005 of EU25 and the EU15 countries shows a difference of 0.4 per cent.

Two other technologies with shorter trend data are featured in Figure 2. While still unfamiliar to many, more are optimistic about the prospects for nanotechnology in 2005 than was evident in 2002. The ratio of optimists to pessimists is eight to one. By contrast, nuclear energy is a different story. From 1999 to 2005 it has been below the line on the index of optimism, meaning that there are more pessimists than optimists. On the positive side one might say that pessimism has decreased over the period, so that there are now 1.2 pessimists to every optimist. The countries in which the percentage of optimists is greater than the pessimists include Finland, Italy, Sweden, Czech Republic, Estonia, Hungary, Lithuania and Slovakia. Strikingly in France with the largest civil nuclear programme in the EU the pessimists out-vote the optimists by around 20 per cent.

Returning to biotechnology, and looking not at the index of technological optimism but at the raw scores, the Eurobarometer surveys show that optimism in biotechnology fell from 50 per cent in 1991 to 41 per cent in 1999 and pessimism rose over the same period from 11 per cent to 23 per cent. From a nadir in 1999, by 2005 there are 52 per cent optimists and 13 per cent pessimists. But how is this change towards greater optimism across Europe as whole reflected at the country level?

Turning to the European country level, Table 1 shows the index of optimism for biotechnology over the period 1991 to 2005. The EU15 countries are ordered from the most to the least optimistic in 2005, followed by the 10 new Member States (ordered in the same way).

Table 1: Trends in the index of optimism for biotechnology

Index score	**1991**	**1993**	**1996**	**1999**	**2002**	**2005**
Spain	82	78	67	61	71	75
Sweden	-	-	42	-	61	73
Portugal	50	77	67	50	57	71
Italy	65	65	54	21	43	65
Denmark	26	28	17	-1	23	56
Luxembourg	47	37	30	25	29	55
Ireland	68	54	40	16	26	53
United Kingdom	53	47	26	5	17	50
France	56	45	46	25	39	49
Netherlands	38	20	29	39	39	47
Belgium	53	42	44	29	40	46
Finland	-	-	24	13	31	36
Germany	42	17	17	23	24	33
Austria	-	-	-11	2	25	22
Greece	70	47	22	-33	12	19
Malta	-	-	-	-	-	81
Estonia	-	-	-	-	-	79
Cyprus	-	-	-	-	-	74
Czech Republic	-	-	-	-	-	71
Lithuania	-	-	-	-	-	66
Hungary	-	-	-	-	-	62
Latvia	-	-	-	-	-	60
Poland	-	-	-	-	-	59
Slovakia	-	-	-	-	-	55
Slovenia	-	-	-	-	-	47

For EU15 it is useful to divide the time period into two phases – pre- and post-1999. In the period 1991-1999 the majority of countries follow the European trend of declining scores on the index of optimism. These are particularly pronounced in the period 1996-1999 in countries including Greece, Denmark and UK. The exceptions to the overall trend are the Netherlands and Germany, where following a decline in the early nineties, the index of optimism shows an upward movement by the end of the decade. A similar upward movement is seen in Austria, where data is available only from 1996.

In the period 1999 to 2005, with the exception of Austria, all the EU15 countries show an upward trend in optimism about biotechnology, with marked increases in Denmark, UK, Italy and Ireland. That across the EU15 the index of optimism in 2005 ranges from 75 in Spain to 19 in Greece shows the striking diversity of opinion across these countries. This is partially reflected in the 10 new Member States where the range is from 81 in Malta to 47 in Slovenia.

Overall, the relatively similar trajectory of public optimism about biotechnology pre- and post-1999 is noteworthy. While the countries have different starting positions they almost all move in a similar direction in the period 1991-1999 (downwards) and then move in the opposite direction (upwards) post-1999. Whatever the explanation (or explanations) it is unlikely to be exclusively at the national level. Were public perceptions in the 1990s dominated by concerns about GM crops and food, while the 2000s saw the emergence of breakthroughs in bio-medical research with its promise of the understanding and alleviation of disease?

3. Evaluating applications of biotechnology

3.1 Gene therapy, pharmacogenetics, GM food and nanotechnology

We now turn from general attitudes about technology to views about four particular technologies: gene therapy; pharmacogenetics; GM food; and nanotechnology. In a set of questions asking for opinions on these four technologies, respondents were first asked if they had ever heard of them. Using the split ballot, each respondent received one of the two versions of the survey in each of which two technologies were presented. The technologies were defined as follows:

Split ballot A

- Gene therapy *which involves treating diseases by directly intervening with the genes themselves*.

- Pharmacogenetics *which involves analysing a person's genetic code in order to create drugs which are tailored to him/her and are more effective.*

Split ballot B

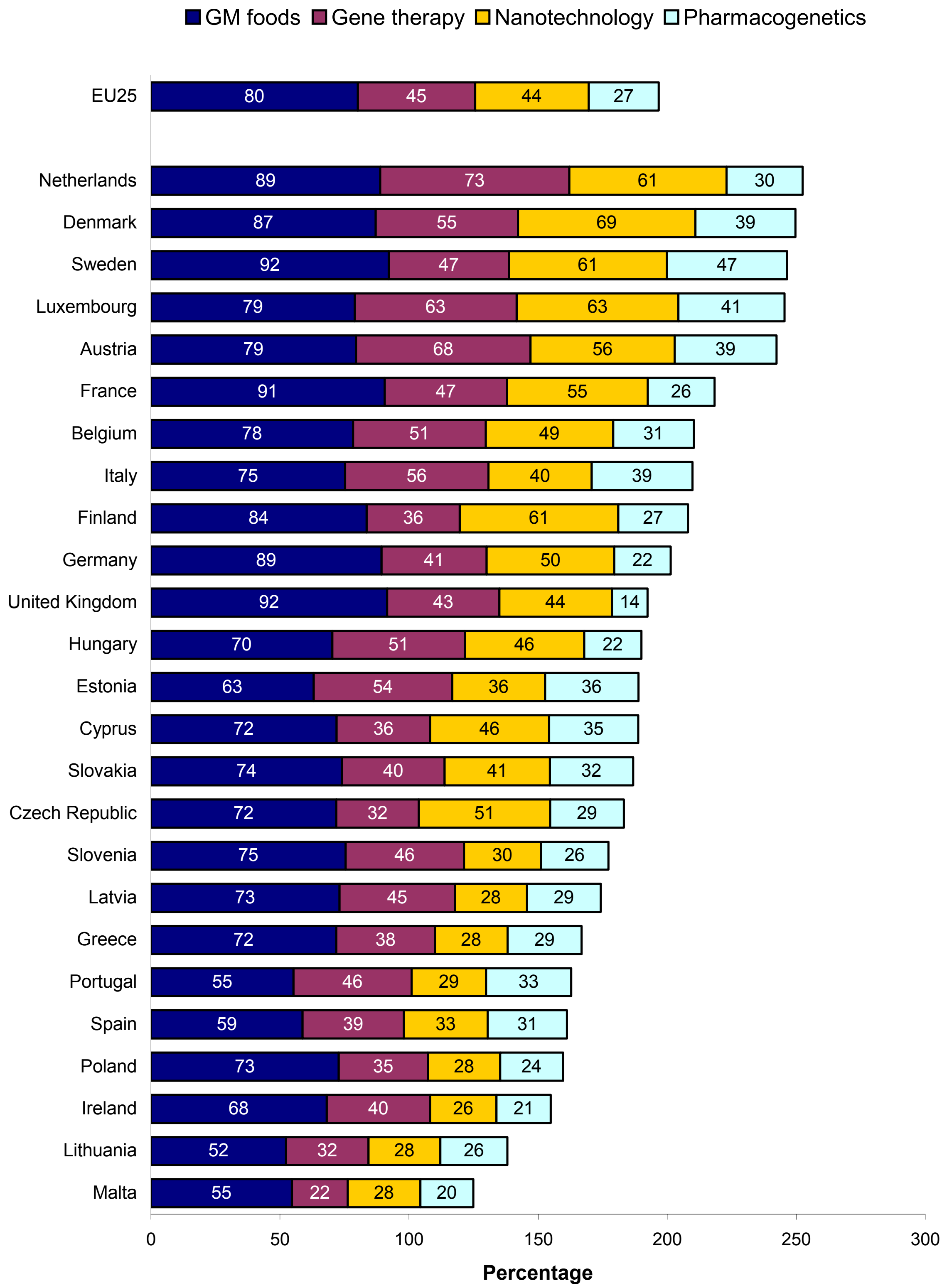
- Genetically modified food (GM food): *made from plants or micro-organisms that have had one or more characteristics changed by altering their genes. For example, a plant might have its genes modified to make it resistant to a particular plant disease, to improve its food quality, or to help it grow faster.*

- Nanotechnology: *involves the construction of tiny structures and devices by manipulating individual molecules and atoms. Some applications of nanotechnology include: turning sea water into drinking water, implantable surgical devices to measure things like blood pressure, molecules to make wrinkle resistant clothes, and cosmetics that are absorbed by the skin.*

Figure 3 shows the percentages of respondents in each EU Member State who said they had heard of each of the applications. (Note that because the percentages for the four technologies are stacked together they sum to a maximum of 400 per cent).

GM food is by far the most familiar across the European Member States: in all countries more than 50 per cent of the public say they have heard of GM food before; this figure is as high as 90 per cent in some countries such as France and UK. The other technologies are known less well and to varying extents across countries. On the whole, pharmacogenetics is the least familiar technology, with as few as 27 per cent of the European population having heard of it; this aggregate figure summarising a range of familiarity, from 14 per cent in the UK to 47 per cent in Sweden.

Figure 3: Familiarity with four technologies

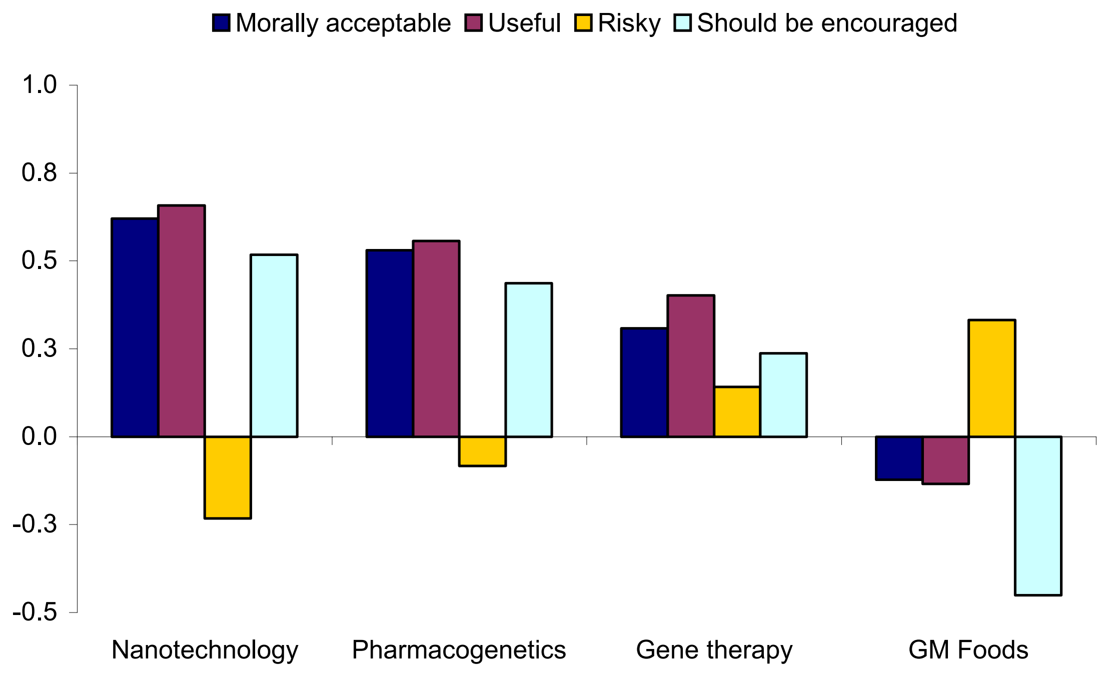


Following the question 'Have your heard of [two of the following: GM food/gene therapy/nanotechnology/pharmacogenetics]?,' respondents were asked whether they thought the different technologies were morally acceptable, useful for society, risky for society, and whether they should be encouraged. The response alternatives for these questions were four-point scales ('totally agree', 'tend to agree', 'tend to disagree' and 'totally disagree').

Figure 4 shows EU-wide mean scores for assessments of these applications, on a scale ranging from +1.5 to –1.5. (The raw data have been recoded from 1 to 4 into -1.5 to +1.5 so that zero represents a mid-point in the figure. Note that all 'don't know' responses are excluded.) The figure shows varying levels of support for these technologies. The European public is most positive about nanotechnology, followed by pharmacogenetics, and then gene therapy, though on balance it regards the latter as risky. By contrast, GM food is predominantly perceived negatively.

As the judged usefulness of technologies declines so is there an increase in perceived risk, along with a decline in perceptions of moral acceptability and overall levels of support. For nanotechnology and pharmacogenetics, agreement that they should be encouraged goes along with the perception that they are not risky. This is mirrored in the case of GM food, for which overall opposition is accompanied by perceptions of relatively high risk. By contrast, gene therapy is supported despite the tendency for it to be perceived as risky (being rated on average above the zero mid-point on this question); it seems that the risk attached to gene therapy is tolerable, whereas for GM food it is unacceptable.

Figure 4: Evaluations of four technologies

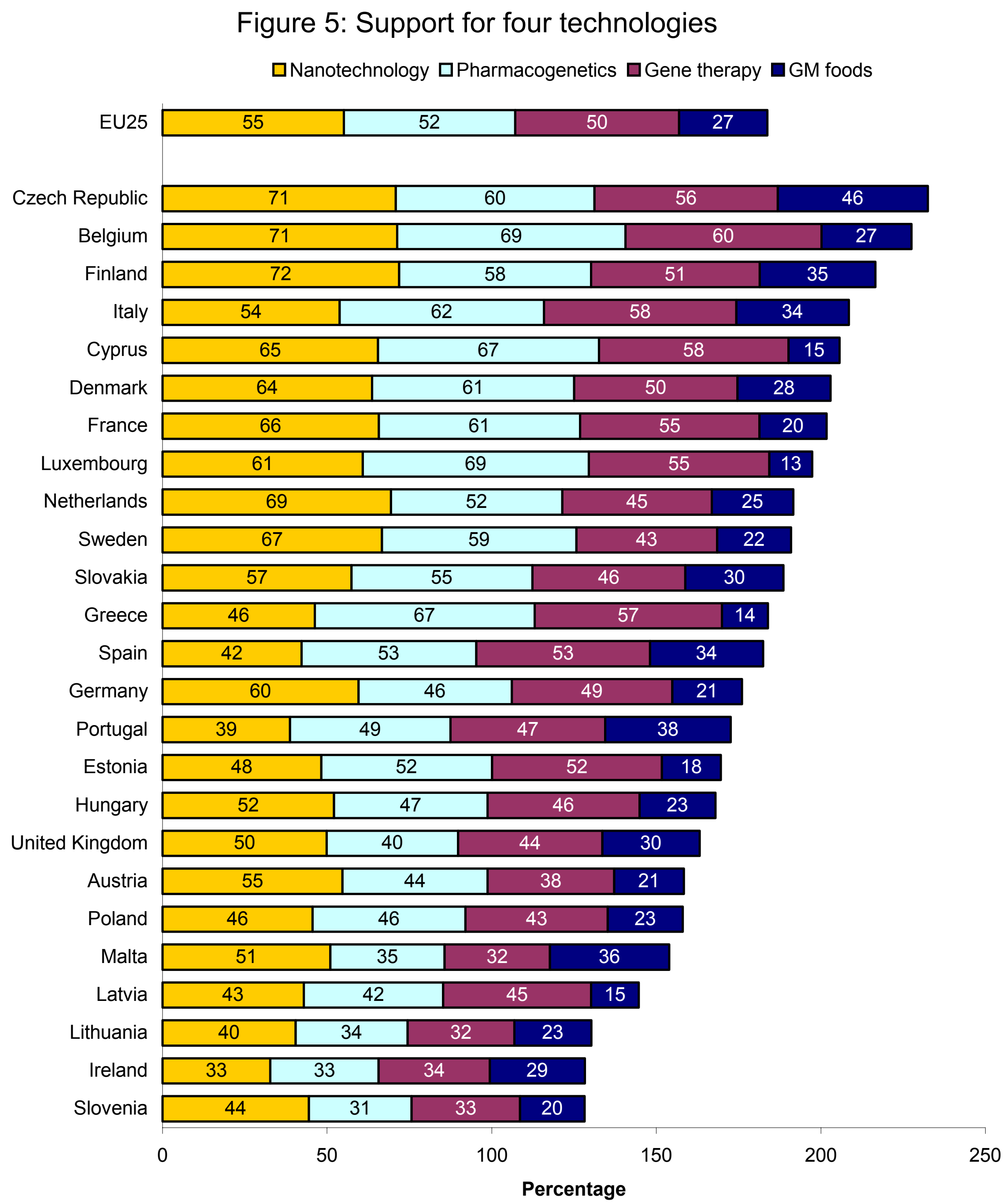


This difference between gene therapy and GM food reflects a general pattern of opinions that has been observed consistently in surveys on biotechnology over the last decade. Gene therapy is a so-called ‘red’ biotechnology, that is a medical application, and as such falls into a general class of red biotechnologies that are regarded as risky but worth the risk. GM food is a ‘green’, agri-food application, which is characteristically regarded as risky but not worth the risk. And here, whether the risk is acceptable or not probably hinges on the perception of the absence of benefits.

It should be noted that the above chart is based on all responses (although excluding ‘don’t knows’), that is for both those who say they have heard of the applications before the interview, and those who have not. However, there is clear evidence of differences in evaluations between those who have heard of a technology and those who have not.

Specifically, those who say they have heard of gene therapy, pharmacogenetics and nanotechnology tend to express notably more positive views than those who are unfamiliar with them. For these technologies people who are familiar with them are more likely than people who are not familiar with them to agree that they are morally acceptable, useful and should be encouraged, and more likely to disagree that they are risky. For GM food a slightly different pattern is found: those who say they have previously heard of GM food are more likely to agree it is morally acceptable and useful, but there is no significant difference in levels of overall support between the familiar and the unfamiliar, and only the smallest difference in terms of risk perception, with the familiar being slightly more likely to say that it is risky.

Looking a little more closely at overall levels of approval (whether the technologies should be encouraged) we see varying levels of support across countries. Figure 5 shows the stacked percentages of respondents who either ‘agree’ or ‘totally agree’ that each application should be encouraged. The countries are ordered by the cumulative sum of percentages for the four applications, so that those at the top can be considered to show higher aggregate levels of support across the range of applications than those at the lower end.



The striking feature of the chart is the low level of support for GM food, relative to the other applications. Even in Spain, where tens of thousands of hectares have been planted with GM maize, support is only 7 per cent above the European average of 27 per cent. The introduction of the new regulations on the commercialisation of GM crops and the labelling of GM food (2001/18/EC)[6] appears to have done little to allay the European public's anxieties about agri-food biotechnology. There is also a general tendency for countries to be more or less supportive across the four technologies. While the Czech Republic is most supportive, a majority of the ten new Member States are among the least supportive of these technologies.

Figure 6 presents a more formal way of classifying different types of support and opposition. This typology was developed and used in previous Eurobarometer surveys on biotechnology, and seems to us to retain its validity. Collapsing the responses for the judgements of moral acceptability, use, risk and encouragement into dichotomies (agree/disagree) results in sixteen possible combinations of responses for each technology, combinations that we call 'logics'. Of these sixteen, we find only three that are used by more than 10 per cent of respondents Europe-wide, for each of the four technologies.

Figure 6: Three common logics

Logic	Useful	Risky	Morally acceptable	Encouraged
Outright supporters	yes	no	yes	yes
Risk tolerant supporters	yes	yes	yes	yes
Opponents	no	yes	no	no

'Outright supporters' are those who agree that the application they are judging is morally acceptable, useful, and to be encouraged, and who don't think it is risky. 'Risk tolerant supporters' agree that the technology is risky but still agree that it is morally acceptable, useful, and to be encouraged. Lastly, 'opponents' agree that the technology is risky, but disagree that it is morally acceptable or useful, and disagree that it should be encouraged. Considering just those respondents who hold one of these three common logics, whom we call 'the decided public', Table 2 shows the relative proportions of respondents in these three groups.

Table 2: Percentage of outright supporters, risk tolerant supporters and opponents among the 'decided public'

	Gene therapy (Base = 51%)	**Pharmacogenetics** (Base = 50%)	**GM food** (Base = 49%)	**Nanotechnology** (Base = 53%)
Outright supporters	44	57	25	66
Risk tolerant supporters	36	33	17	25
Opponents	20	10	58	9

The striking feature of Table 2, echoing Figures 4 and 5, is the strong opposition towards GM food, with 58 per cent opponents and 42 per cent supporters (combining outright and risk-tolerant support). The other three technologies receive overwhelming support when the two different types of support are combined. Moreover, across the four applications, we find that amongst the supporters, it is more common to perceive a technology as not risky, than as risky. This is particularly true of nanotechnology, where the majority view (66 per cent) is positive and without concern that the technology is risky.

It is important to note that these proportions are based only on those 50 per cent or so of respondents who give one of the three common logics as a response: those giving a different combination, including any containing one or more 'don't know' response, are excluded. So it would not be valid to say that, for example, 58 per cent of Europeans are opposed to GM food; our analysis shows that *among the 'decided public,'* 58 per cent of respondents oppose GM food.

Comparing data for the questions on GM food with previous survey waves, we can track levels of support for this technology over time. Table 3 shows, for those respondents adopting one of the three common logics, the combined percentage of outright supporters and risk tolerant supporters. For ease of comparisons, we list the former EU15 countries at the top of the table, ordered by support in 2005, with the new countries following, again ordered by levels of support. With a few exceptions, among the former EU15 countries we see the tendency of a steady decline in support between 1996 and 1999, an increase between 1999 and 2002, and a return to a decline in support in 2005. The decline between 2002 and 2005 is striking; in many countries levels of support drop below those reported in 1996. Further analysis shows this is due to a relative decrease in numbers of risk tolerant supporters, offsetting the slight *increase* in outright support found in many countries. In 2005 fewer people are prepared to discount the perceived risks of GM food against prospective benefits.

Table 3: Outright support and risk tolerant support for GM food across EU25

	1996	1999	2002	2005
Spain	80	70	74	74
Portugal	72	55	68	65
Ireland	73	56	70	55
Italy	61	49	40	54
Netherlands	78	75	65	48
United Kingdom	67	47	63	48
Finland	77	69	70	46
Belgium	72	47	56	45
Denmark	43	35	45	42
Sweden	42	41	58	32
Germany	56	49	48	30
France	54	35	30	29
Austria	31	30	47	25
Luxembourg	56	30	35	20
Greece	49	19	24	12
Malta	-	-	-	66
Czech Republic	-	-	-	64
Lithuania	-	-	-	54
Slovakia	-	-	-	48
Hungary	-	-	-	37
Poland	-	-	-	36
Slovenia	-	-	-	33
Estonia	-	-	-	31
Latvia	-	-	-	19
Cyprus	-	-	-	19

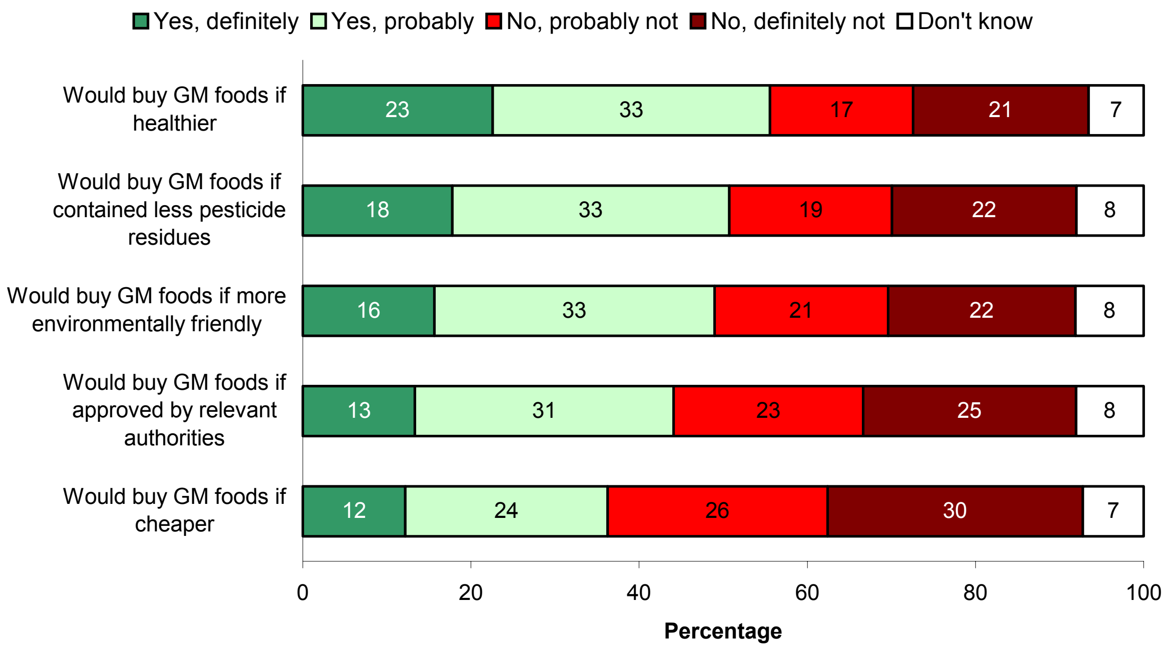
3.2 Reasons for buying or not buying GM food

Another set of questions in the survey adds a new dimension to the discussion on GM food. Respondents were asked if they would consider purchasing GM food under a number of conditions. These were:

- *I would buy genetically modified food if it were healthier.*
- *I would buy genetically modified food if it contained less pesticide residues than other food.*
- *I would buy genetically modified food if it were grown in a more environmentally friendly way than other foods*
- *I would buy genetically modified food if it were approved by the relevant authorities.*
- *I would buy genetically modified food if it were cheaper than other foods.*

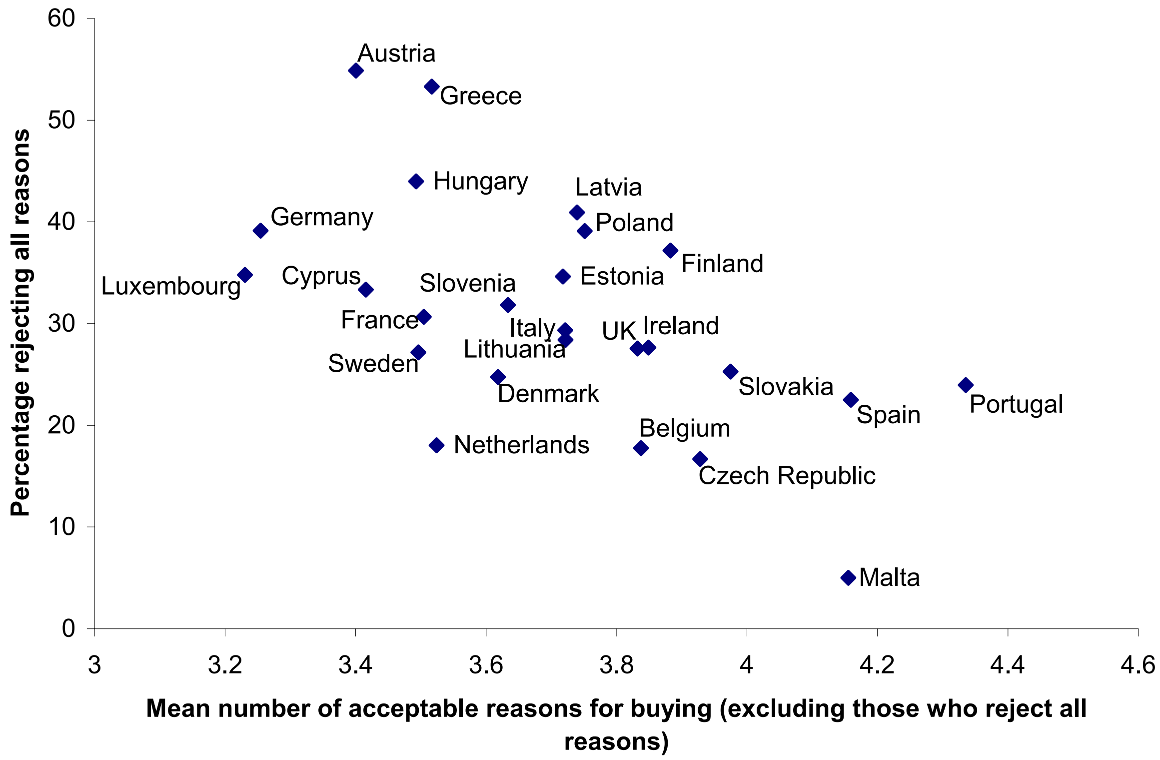
In terms of choice intentions, the two health related reasons for buying GM food are the most convincing. Combining 'yes, definitely' and 'yes, probably', 56 per cent would buy GM food if it were healthier, and 51 per cent would buy it if it contained less pesticide residues. While environmental benefits attract more potential purchasers than non-purchasers, European opinion is clearly split on this. Neither approval by the relevant authorities nor lower prices appear to be persuasive reasons in people's choice intentions. While economics tells us that price is a key determinant of people's actual choices, in this hypothetical situation some may be responding as citizens rather than as consumers.

Figure 7: Reasons for buying or not buying GM foods



When considering the data for 25 European countries, we find that the distribution of responses is such that a mean score reflecting the number of acceptable reasons for buying GM foods is meaningless. In some countries more than 50 per cent of respondents reject all five reasons. To depict the data in an economical and informative manner, Figure 8 plots the position of each country on two dimensions. The Y (vertical) axis shows the percentage of those in a country who reject all the reasons (potential non-buyers who say 'no, definitely not' or 'no, probably not'). The X (horizontal) axis is the mean number of acceptable reasons for buying GM food amongst those remaining respondents who did not reject all the reasons (potential buyers), in other words the mean number of 'yes, definitely' and 'yes, probably' responses for these people.

Figure 8: Acceptable reasons for buying GM food



The first point to note is that there is a weak negative association between the percentage of 'non-buyers' and the mean number of acceptable reasons for the 'potential buyers' (at the country level). In other words, in countries where there are many 'non-buyers' we find also fewer acceptable reasons for buying among the 'potential buyers.'

Scanning from the bottom of the figure to the top, it can be seen that Malta, the Czech Republic, Belgium and the Netherlands have the lowest percentage of 'non-buyers' while Austria, Greece, Hungary, Germany, Latvia and Poland have approximately 40 per cent or more 'non-buyers'.

Scanning from the right hand side to the left hand side of the figure, we see that amongst the potential buyers, people in Portugal, Spain, Malta and Slovakia are persuaded by about four or more of the reasons. By contrast, Luxembourg, Cyprus and Germany are persuaded by only around 3 reasons, on average.

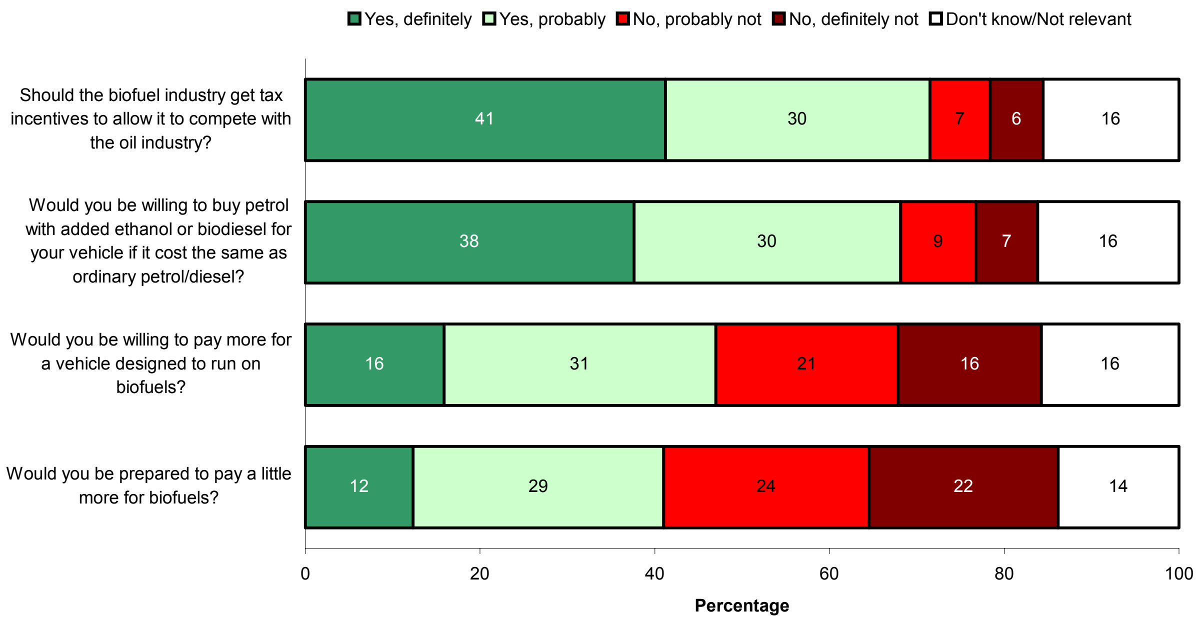
Across all the countries it is notable that the mean number of acceptable reasons amongst the potential buyers, at 3.6, is relatively high, indicating that the public is split on this issue. The non-buyers operate a total veto, but once a threshold of minimal acceptability is reached, then people are inclined to find a number of the reasons acceptable for buying GM foods.

3.3 Industrial (white) biotechnology

As well as GM food, the survey asked for opinions on two less well known biotechnologies, the so-called ‘white’ biotechnologies, that is industrial applications (contrasted with the ‘red’ medical applications and the ‘green’ agricultural or food applications). The first of these was bio-fuels, defined for the respondent as *the development of special crops that can be turned into ethanol as a substitute or additive for petrol and for biodiesel*.

Figure 9 summarises the balance of opinion across Europe. Overall, feelings are positive about bio-fuels: 71 per cent of Europeans would be in favour of giving the bio-fuels industry ‘tax incentives to allow it to compete with the oil industry’. A clear majority (68 per cent) would choose bio-fuels over ordinary fuels in their regular purchases provided they incurred no extra cost. However, respondents are less enthusiastic when it hits their pockets. Just less than half (47 per cent) of respondents would be prepared to pay more for a vehicle designed to run on bio-fuels, and fewer again (41 per cent) would be willing to pay more for bio-fuels. The balance of opinion on this item is marginally negative, with 46 per cent respondents stating their unwillingness to spend more on bio-fuels.

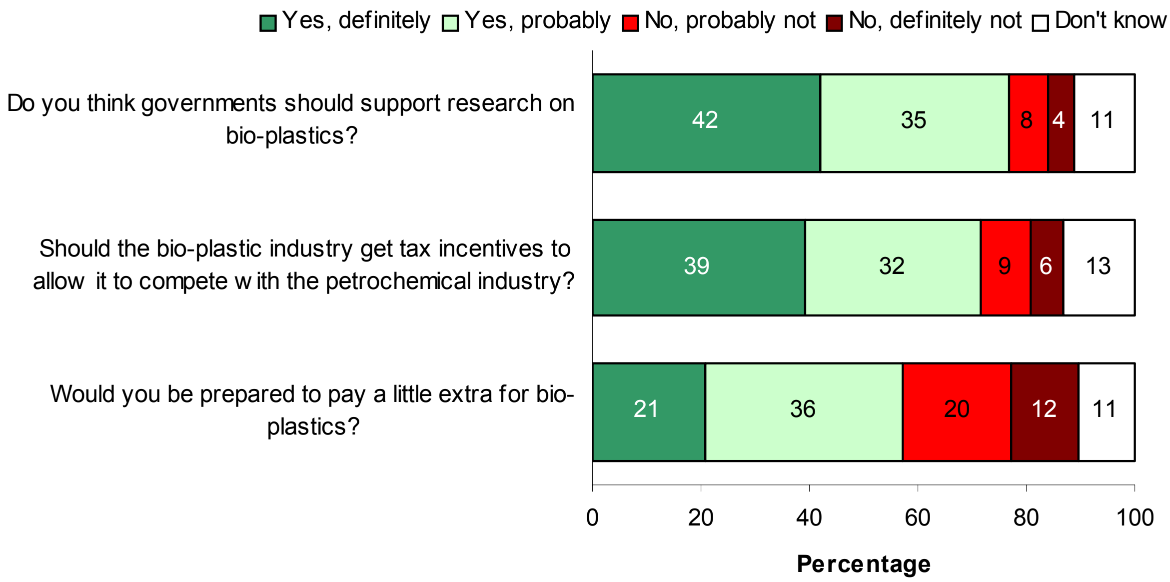
Figure 9: Opinions about bio-fuels



A second white biotechnology put to respondents was bio-plastics, defined as follows: *Another industrial use of crop plants is the manufacture of bio-plastics. These, it is claimed, will be less environmentally damaging as they can be easily recycled and are bio-degradable*.

Figure 10 shows the European picture. Once again we see that relatively speaking, Europeans would prefer to place the burden of support for this technology on governments and the 'invisible hand' of the market, and show less enthusiasm for supporting the use of bio-plastics by investing in them through their own consumer choices. A very similar proportion of respondents, 71 per cent, would be in favour of tax incentives for the bio-plastics industry. However, more Europeans say they would pay more for bio-plastics than say they would pay more for bio-fuels – 57 per cent compared to 41 per cent respectively. What might account for this difference? The relatively high price of petrol in recent months? Or perhaps the presumption that bio-plastics is mainly for packaging which costs relatively little in the overall price of a particular product.

Figure 10: Opinions about bio-plastics



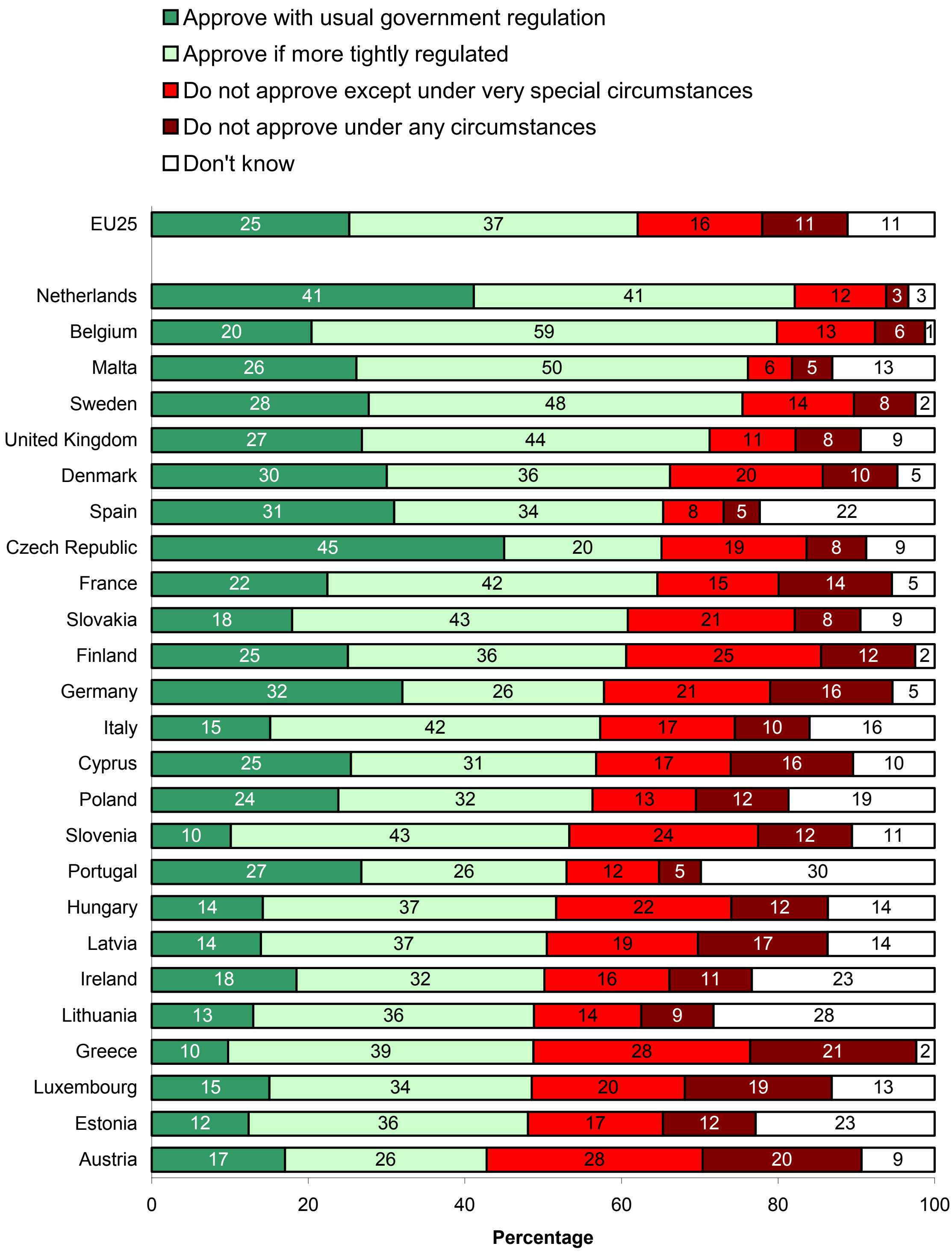
Finally, respondents were asked their opinion on another very new biotechnology, as follows:

> *Another application is the use of genetically modified plants in the production of medicines and pharmaceutical products. These genetically modified plants will be grown in enclosed greenhouses and the expectation is that this could be a cheaper and more efficient way of manufacturing medicines. Which of the following best describes your views?*

For this technology respondents were asked not for their general positive or negative feelings but for their approval in relation to levels of regulation (see Figure 11). We can think of this question as capturing two elements of perceptions of biopharming; general attitudes towards the technology, and attitudes towards relevant authorities governing its use. For the 25 per cent of Europeans who say they approve of this use of biopharming with the usual levels of government regulation, we might suppose that these respondents not only feel positive about biopharming, but also have confidence in government and its regulatory capacity.

To the 37 per cent who approve of biopharming if it is tightly regulated, we can attribute a less relaxed attitude. Perhaps this is a positive attitude towards the technology but a hint of anxiety about its regulation, or a lukewarm attitude towards biopharming, that would only be offset by strong regulation. The 16 per cent who do not approve except under special circumstances might be supposed to hold broadly negative views of biopharming along with low levels of confidence in regulation or regulators. Finally, for the 11 per cent who do not approve under any circumstances, it seems plausible to say that these respondents are opposed to the use of the technology per se; in which case, confidence in regulation may not be an issue. Figure 11 shows the varying levels of support for biopharming across EU25. Only in Austria is there less support than opposition.

Figure 11: Support for biopharming



Overview

Europeans support the development of nanotechnology, pharmacogenetics and gene therapy. All three technologies are perceived as useful to society and morally acceptable. Neither nanotechnology nor pharmacogenetics are perceived to be risky. While gene therapy is seen as a risk for society, Europeans are prepared to discount this risk as they perceive the technology to be both useful and morally acceptable.

Industrial applications of biotechnology in bio-fuels, bio-plastics and plants used for pharmaceutical production (biopharming) are also widely supported in Europe, with people agreeing on incentives to develop bio-fuels and plastics. More people than not say they would pay more for a vehicle that runs on bio-fuels and for bio-plastics. Around six in ten approve of biopharming providing that it is tightly regulated.

However, the contrast with GM food is striking – it is widely seen as not being useful, as morally unacceptable and as a risk for society. Overall, Europeans think GM food should not be encouraged. There are mixed opinions on the acceptability of buying GM food. The most persuasive reasons relate to health, the reduction of pesticide residues and environmental impacts. Whether GM food is approved by the relevant authorities or is cheaper are not convincing.

Why is GM food still a problem, after the Directive, 2001/18/EC, on the commercialisation of GM crops with the introduction of labelling and other measures, designed in part to reassure the public? And that GM food is still an issue may not bode well, in some countries at least, for the development of plans for the co-existence of GM, conventional and organic agriculture. That said, both the Netherlands and Denmark have come to an agreement on co-existence after long public debates, notwithstanding overall opposition to GM food.

Clearly, some of the European public entertain concerns about health and environmental impacts and could the moratorium have reinforced such concerns – why would there be a moratorium if there were no problems? Maybe the World Trade Organisation (WTO) ruling against Europe led people to ask ‘why should we be dictated to by outsiders? Why should a WTO view trump European values and preferences?’ Or is the problem with GM food one of stigmatization? The years of controversy have led many people in Europe to believe that anything to do with GM food is undesirable[7].

What is also clear, however, is that views about GM food have not coloured people’s opinions about other developments in biotechnology or nanotechnology.

4. Stem cell research

4.1 Opinions on stem cell research

The regulation of the use of stem cells in research has been hotly debated in a number of European countries, particularly Italy and Germany. As indeed it has in the US, Canada and the United Nations. Embryonic stem cell research brings together two deeply rooted ethical positions. On the one hand is the argument for the sanctity of human life from the moment of conception; on the other hand is the imperative to support research that may alleviate human suffering. In societal debates a key point of contention is the ethical issues around the source of the stem cells. For some scientists, embryonic stem cells, with their potential to develop into the organs of the body, are considered more promising than adult stem cells, for which the degree of plasticity is not clear. But some religious leaders and ethicists argue that, notwithstanding their potential benefits, embryonic stem cell research would be an instrumentalisation of human beings and should be prohibited[8]. These discussions have been accompanied by intense media reporting. In this section we explore public sentiments towards these issues.

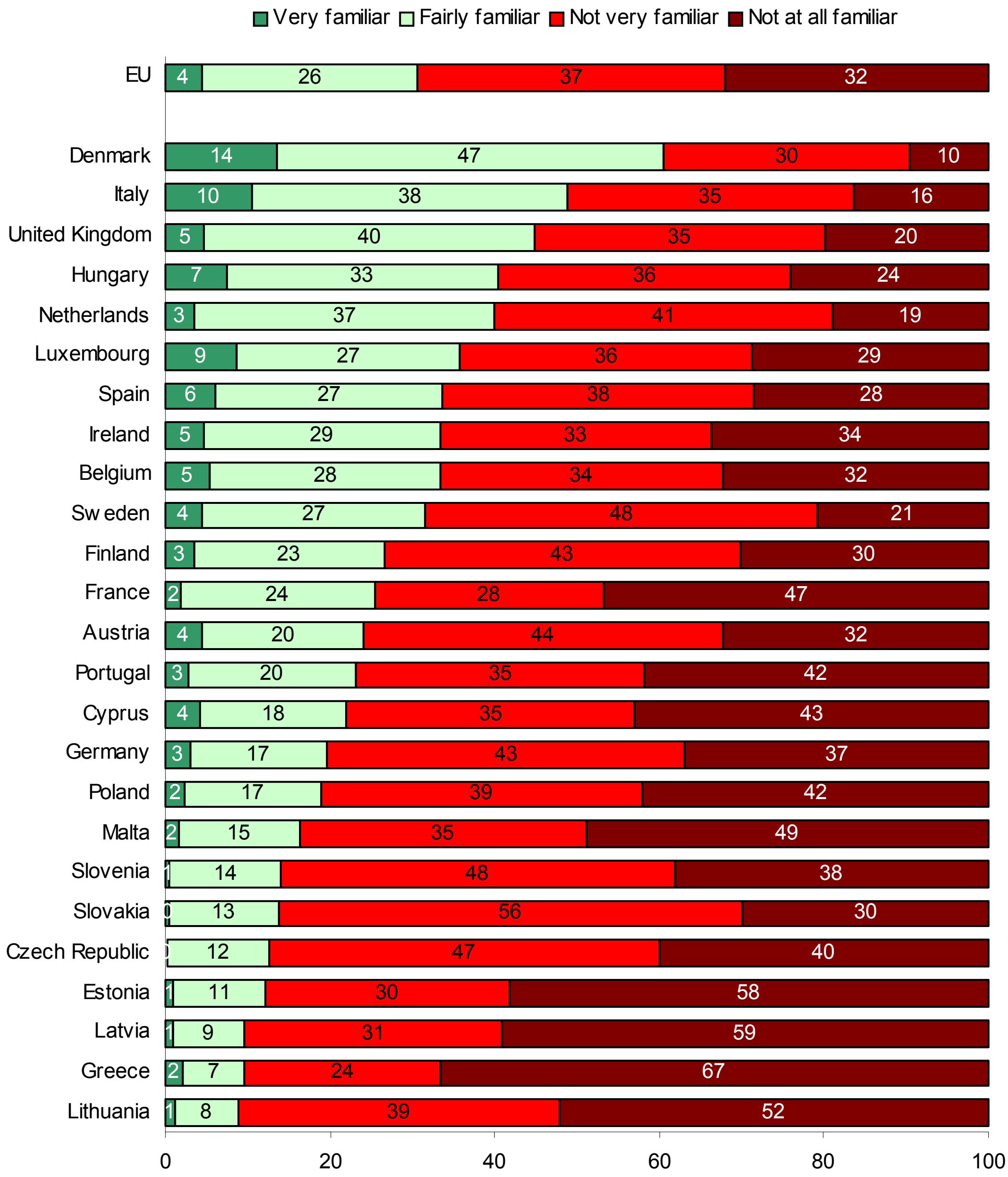
In the Eurobarometer, respondents were presented with a short description of stem cell research:

Stem cell research involves taking human cells either from human embryos that are less than two weeks old that will never be transplanted into a woman's body, or from the blood in umbilical cords. These stem cells can be used to grow new cells to treat certain diseases in any part of the body.

Respondents were asked whether they were 'very', 'fairly', 'not very' or 'not at all' familiar with stem cell research. Only four per cent of Europeans claim to be very familiar with this type of research (Figure 12). Another 25 per cent say they are fairly familiar. Larger proportions say they are not very familiar (35 per cent) or not at all familiar (30 per cent) with the topic. But the variation across Europe is striking. Familiarity is greatest in Denmark, followed by Italy and UK. Levels of awareness are lowest in some of the new Member States as well as in Greece.

Differing degrees of awareness are to be expected as the public debate over the use of stem cells, in particular when harvested from embryos, has been more intense in some countries than in others. One might expect to see a relation between the extent of societal and political debate and public awareness of the issue. While this holds true for Italy, such is not the case in Germany.

Figure 12: Familiarity with stem cell research across Europe



Although the majority of Europeans are not very, or not at all familiar, with stem cell research, expectations are high. When asked if '*Stem cell research will help with cures and treatments for serious diseases*', 32 per cent of Europeans strongly agree and a further 44 per cent tend to agree. Only 9 per cent disagree.

Respondents were asked one question about embryonic stem cells and another question on stem cells from umbilical cords (non-embryonic):

1. *Overall, which of the following best captures your view about research using embryonic stem cells:*
2. *Now I would like to ask you the same question under a different scenario. Suppose scientists were able to get all the stem cells they needed for research from umbilical cords, and no longer had to get them from embryos. Which of the following would best capture your view:*

The response alternatives for both questions were as follows:

- *I approve the use of stem cell research so long as the usual levels of Government regulation are in place*
- *I approve the use of stem cell research if it is more tightly regulated*
- *I do not approve of stem cell research except under special circumstances*
- *I do not approve of stem cell research under any circumstances*

Figure 13 shows that while there is more support, on average, for non-embryonic stem cell research, the difference is not large. Overall, 23 per cent of Europeans approve of embryonic stem cell research with the usual regulations, the figure for non-embryonic stem cells is 28 per cent; even allowing for around 15 per cent 'don't know' responses for both questions, 59 per cent of Europeans approve of embryonic stem cell research and 65 per cent approve of non-embryonic stem cell research, providing each is tightly regulated. If not approving of stem cell research under any circumstances can be taken as a veto, this view is expressed by just under 10 per cent.

Figure 13: European views on embryonic and non-embryonic stem cell research

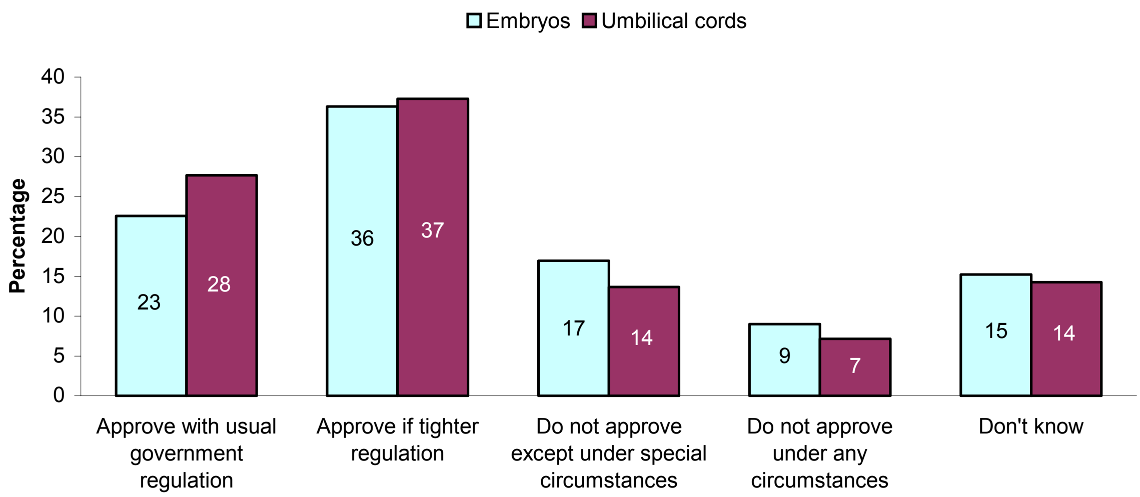
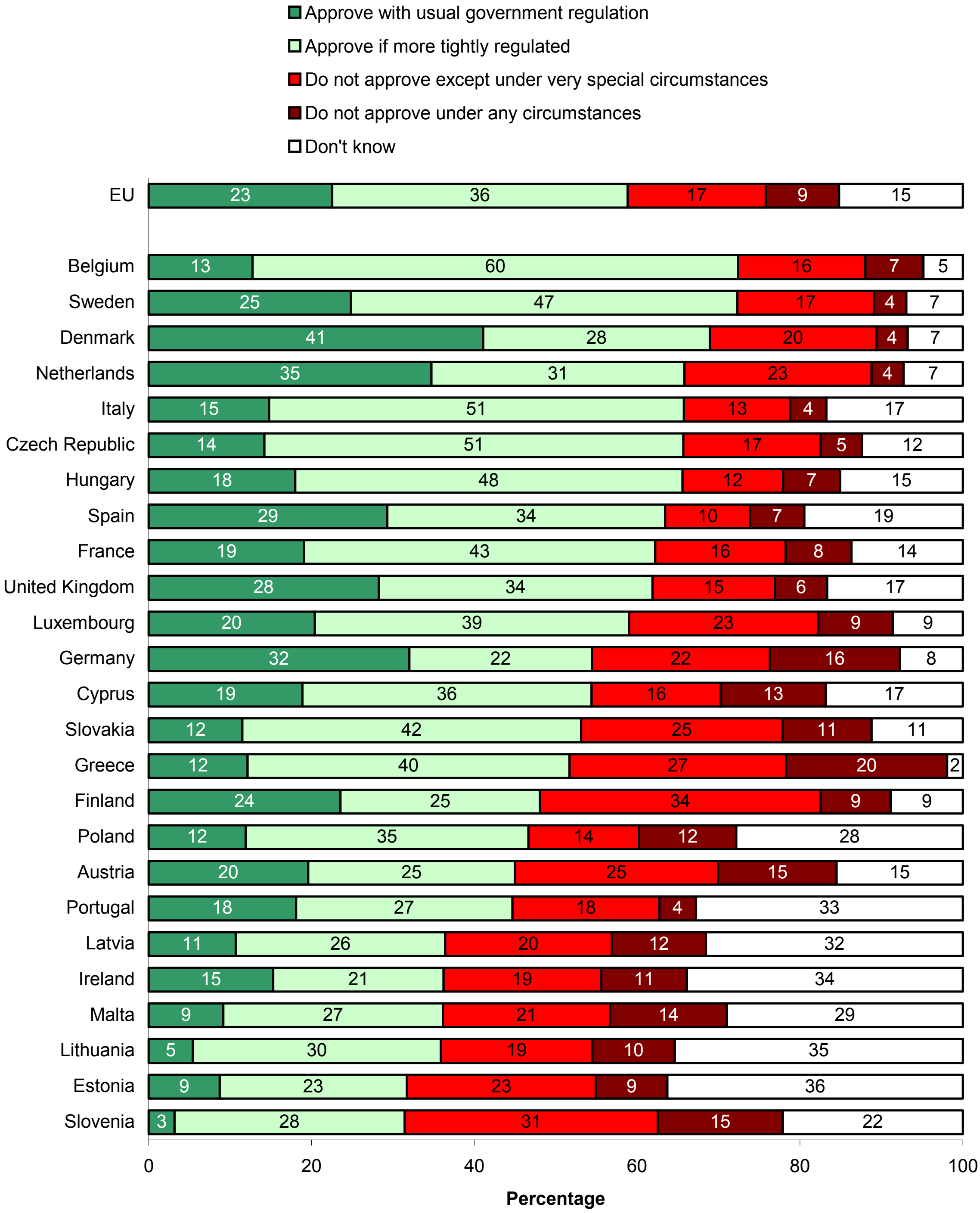


Figure 14 shows levels of support for embryonic stem cell research across Europe. There are a number of features to note. Providing stem cell research is tightly regulated, an absolute majority in 15 countries approve (in Figure 14, Belgium down to Greece).

Figure 14: Views on embryonic stem cell research across Europe



While there are substantial variations in levels of approval and disapproval across Europe, the main religious denomination of the country (which we might expect to be related to the climate of public opinion of the country) does not appear to be a decisive factor in shaping attitudes towards embryonic stem cell research. Amongst the countries where approval is the highest we find traditional Protestant and Catholic cultures side by side. Levels of support are highest in Belgium and Sweden, where more than 70 per cent of the population approves of embryonic stem cell research; with more than 60 per cent approval are Denmark, Netherlands, Czech Republic, Italy, Hungary, Spain and UK. The lowest levels of approval, under 50 per cent, often combined with a relatively high percentage of 'don't know' responses are found primarily in some of the new Member States, along with Ireland and Portugal.

Finally, of the countries that signed the 'Ethical declaration' against embryonic stem cell research in 2005, a majority of the public in Italy and Germany support stem cell research, there are more supporters than opponents in Poland and Austria, Malta is evenly divided and in Slovakia there are more opponents than supporters. In 2006 Italy withdrew from the 'Ethical declaration'.

Table 4 shows the levels of approval (combining 'with usual regulation' and 'with tighter regulation') for embryonic and non-embryonic stem cell research. Almost without exception, there is greater support for non-embryonic stem cell research than for embryonic stem cell research.

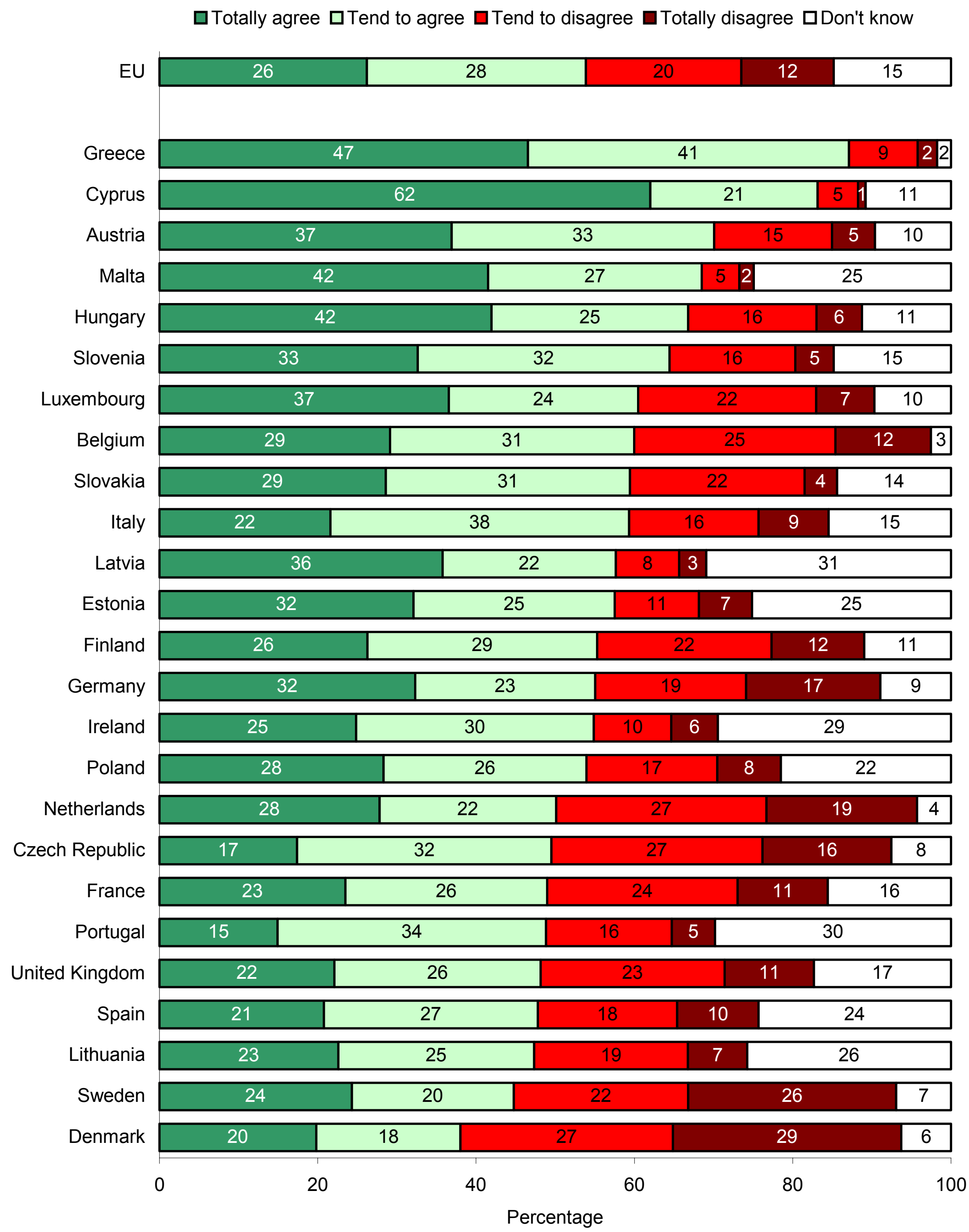
Although it might be expected that the differences would be greater in those countries were the public is more familiar with the stem cell issue, or in those countries where the national religion is Roman Catholicism, the findings do not support these expectations.

Table 4: Approval for Embryonic and non-embryonic stem cell research

% approval	**Embryonic**	**Non-embryonic**
Italy	79	82
Spain	79	81
Sweden	78	85
Hungary	77	83
Belgium	76	82
Czech Republic	75	82
United Kingdom	74	81
Denmark	74	81
France	72	77
Netherlands	71	84
Cyprus	69	80
Luxembourg	67	67
Portugal	66	77
Poland	65	71
Slovakia	60	71
Germany	59	67
Malta	57	71
Ireland	55	65
Lithuania	55	63
Austria	53	60
Greece	53	59
Finland	53	67
Latvia	52	56
Estonia	47	60
Slovenia	40	52

The relatively small difference in levels of approval for research with embryonic and non-embryonic stem cells speaks to a fundamental aspect of the debate over stem cell research – is the fertilised embryo a human or not? In the survey respondents were asked to agree or disagree with the following statement: '*Immediately after fertilisation the embryo can already be considered to be a human being*.' 54 per cent of Europeans agree with this statement, while 32 per cent disagree (Figure 15).

Figure 15: Is the immediately fertilised embryo human? Beliefs across Europe



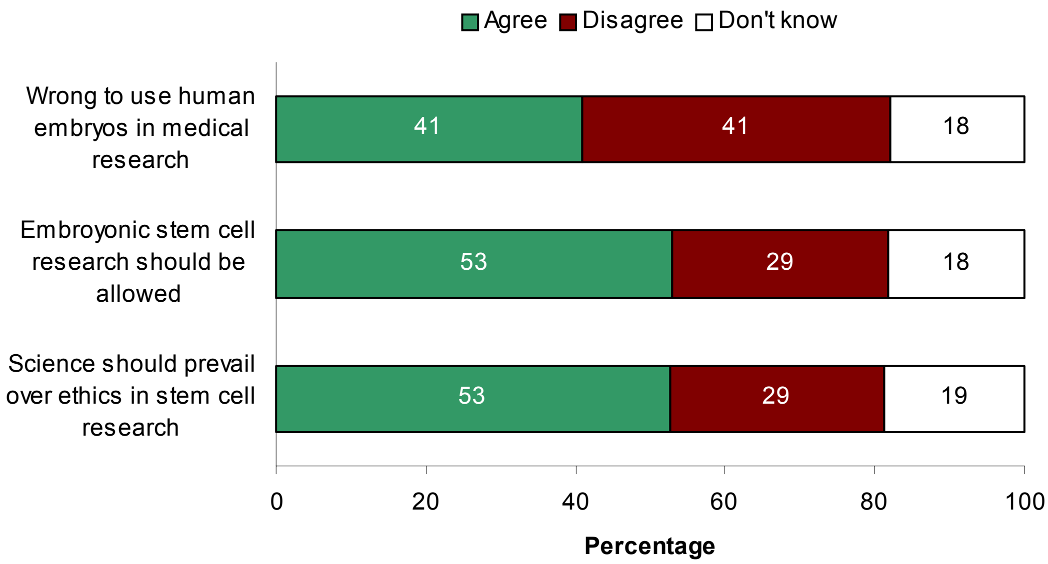
The picture across Europe is not uniform. In the predominantly Orthodox cultures of Greece and Cyprus, respondents regard the embryo as a human being. The same can be said of the traditionally Roman Catholic cultures such as Italy, Hungary, Spain and Belgium, where, as we have seen, levels of approval for embryonic stem cell research are relatively high. The respondents in the Protestant cultures are less inclined to agree that the embryo is human immediately after conception, as are those in the more secular countries.

Whether people believe the embryo is a human is related to their approval for stem cell research. Of those who believe so, 36 per cent disapprove of embryonic stem cell research, compared to 20 per cent disapproval among those who do not believe the embryo is a human being. But looking across the European countries as a whole, a belief in the embryo as a human being at the moment of conception does not appear to be the decisive factor in shaping sentiments towards human embryonic stem cell research.

Respondents were asked about three further statements about ethical issues relating to stem cell research:

- *It is ethically wrong to use human embryos in medical research even if it might offer promising new treatments.*
- *We have a duty to allow research that might lead to important new treatments, even when it involves stem cells from human embryos.*
- *Should ethical and scientific viewpoints on stem cell research differ, scientific viewpoint should prevail.*

Figure 16: Ethical issues around stem cell research



Confronted with an ethical dilemma, pitting the possible development of new medical treatments against the protection of the human embryo, Europeans are divided (Figure 16). Around 40 per cent think that it is wrong to use embryos in medical research even if it might offer promising new treatments. On the other hand, 40 per cent of Europeans take the opposite view.

When the dilemma is posed another way – the duty to pursue research that might lead to new treatments, even if this involves embryonic stem cells – Europeans tend towards a utilitarian position: 53 per cent of Europeans agree with this statement, while 29 per cent do not.

A final dilemma concerns disagreement between science and ethics; which position should prevail? Here, Europeans lean towards a priority for science, with 53 per cent agreeing that science should prevail and 29 per cent disagreeing.

While there is widespread approval for stem cell research, even for embryonic stem cell research, the tension between the deontological (moral absolutes) and the utilitarian (contingent) moral positions is not merely an expert issue. It is evident in the views of the European public. But of these two positions, Europeans lean towards the utilitarian view.

This interpretation is supported by findings in the next section. When asked what they would like to know more about on the issue of stem cell research, 39 per cent of the European public said 'benefits and risks', 14 per cent 'current regulations' and 15 per cent 'who is responsible for the moral limits'.

Returning to religion – already considered insofar as it might contribute to the explanation of country differences – we now consider the individual level. How might the role that religion plays in people's lives (as evidenced by frequency of attendance at religious services) relate to their views on stem cell research?

Table 5: Frequency of religious service attendance and approval of stem cell research

		Apart from weddings or funerals, about how often do you attend religious services?			
% responses		**Once a week or more**	**Between once a month and once in three months**	**Only on special holy days/about once a year**	**Less often than once a year/never**
Overall approval of embryonic stem cell research	**Approve with usual government regulation**	14	18	22	29
	Approve if more tightly regulated	31	38	41	35
	Do not approve except under very special circumstances	18	20	17	15
	Do not approve under any circumstances	15	8	8	7
	Don't know	22	16	12	14
	Total	100	100	100	100

Table 5 shows that there is a clear relationship between religious practices and views about stem cell research. Those who hardly ever attend religious services are those most approving, and the frequent attenders least approving.

However, among those who frequently and regularly attend religious services 26 per cent are ready to approve of research under current regulation and a further 63 per cent would approve with more stringent regulation in place. The findings suggest that although religion may be of prime importance in many people's lives, it does not preclude support for the use of human embryonic cells for research purposes.

Overall, there is support for stem cell research in most European countries; much of this support is granted providing such research is tightly regulated. Stem cell research raises a number of ethical dilemmas and on these opinion in Europe is divided. Religious commitment may be one factor in the formation of people's views, but by no means the only one. The imperative to seek cures for diseases is also influential as is familiarity with stem cell research, since the findings suggest higher levels of support amongst the better informed publics.
However, with support contingent on benefits, the question is raised as to whether the projected benefits of stem cell research, widely reported in the mass media, are realistic or hyperbole; for if it is the latter support is likely to evaporate.

4.2 What information do people want about stem cell research?

Inevitably people often lack detailed knowledge about technological innovation. And it is hardly realistic to expect the public to study such things in detail. Rational ignorance is well documented in many aspects of public affairs. Nevertheless, people are sometimes called upon to make up their mind and come to a judgement. What information do people then use to evaluate complex technologies? What pieces of information do they regard as relevant, and what questions would they like to be answered?

Respondents were asked which of a selection of types of information they would like to form an opinion about embryonic stem cell research. More precisely they were asked:

> *'If there was a referendum on embryonic stem cell research and you had to make up your mind how to vote, what would be, among the following, the issue on which you would like to know more?'*

Respondents were asked which two out of five issues would be of most interest to them:

- *What scientific processes and techniques are being used?*
- *What are the claimed benefits and what are the possible risks?*
- *What are the current regulations and who is enforcing the regulation?*
- *Who is responsible for setting the moral limits?*
- *Who is funding the research and who will benefit from it?*

Figure 17 shows that, across all 25 EU States, people most want to be informed about potential benefits and possible risks of embryonic stem cell research. Out of those respondents who expressed a choice (that is, excluding those who say they ‘don’t know’) 69 per cent select ‘benefits and risks.’ 40 per cent want to know more about current regulations and about who is enforcing them, 36 per cent express interest in who is responsible for setting moral limits, 33 per cent want to know what scientific processes and techniques are used, and 22 per cent want to hear about who is funding the research and who will benefit from it.

Figure 17: What information would people want about embryonic stem cell research?

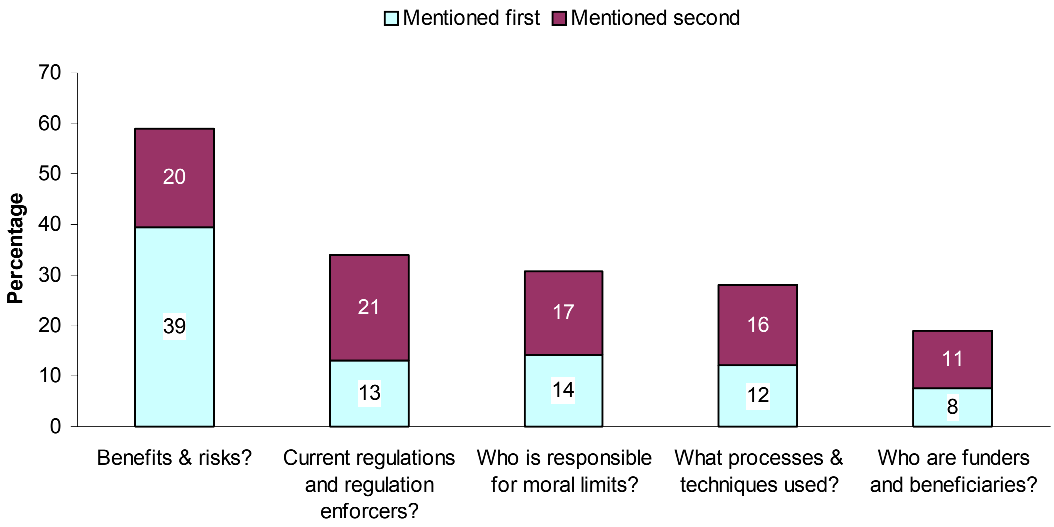
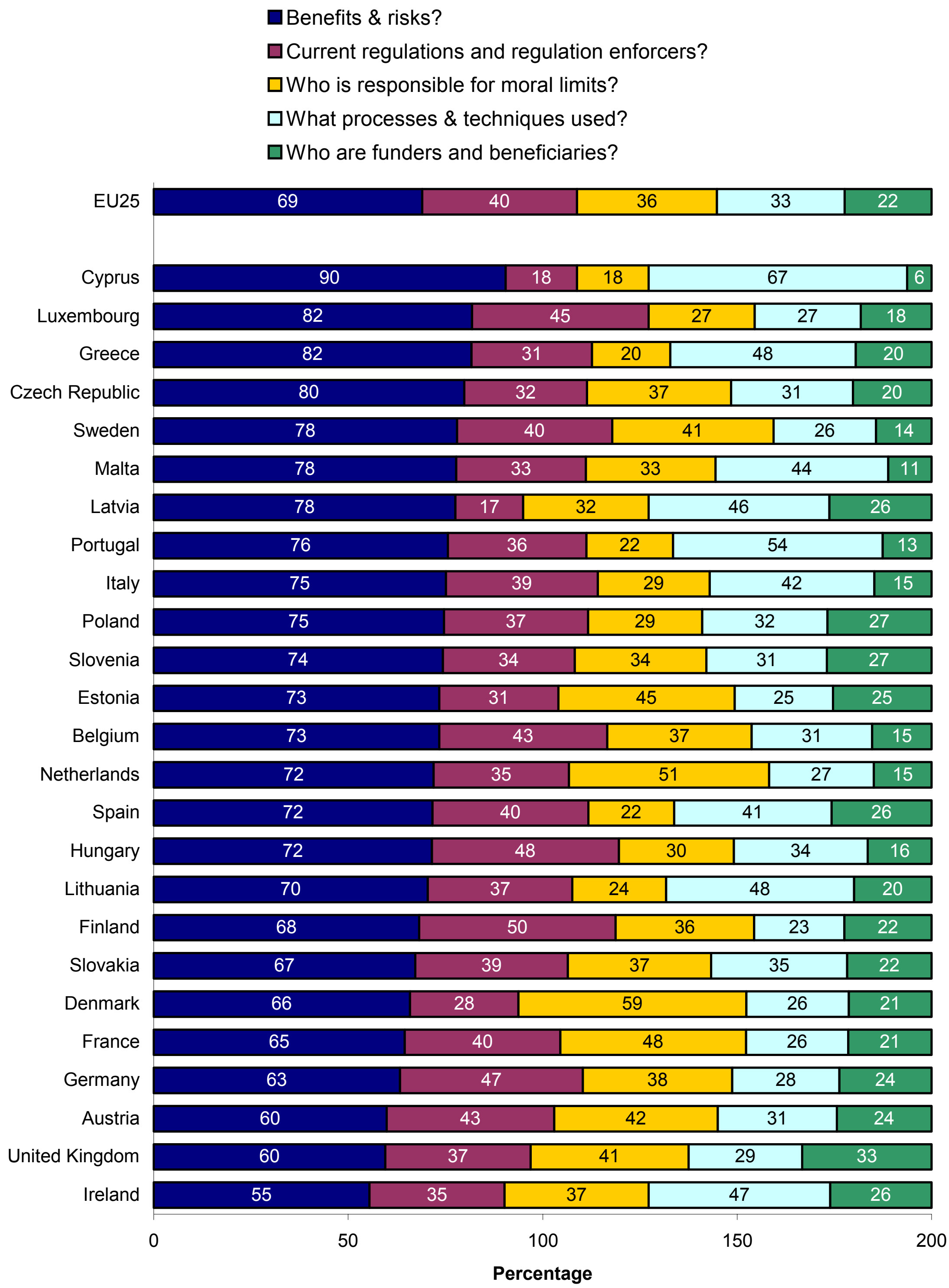


Figure 18 shows what the public want to know about stem cell research. Note that the percentages sum to 200 per cent since each respondent selected two pieces of information. The interest in information on potential benefits and possible risks is observed in virtually all European Member States. Where we see national differences, it is in interest in regulatory issues and scientific details. While in southern European countries, like Cyprus, Portugal or Greece, more than a third of the respondents consider scientific details important to their decision-making on embryonic stem cell research, in countries like Germany, France and others in the north of Europe it is only about one quarter. In these latter countries there is more demand for information on regulation (e.g. Finland, 50 per cent), the identity of funders and beneficiaries (e.g. UK, 33 per cent) and on the setting of moral limits (e.g. Denmark, 59 per cent). It might be hypothesised that in countries like Germany, where the issue of embryonic stem cell research has been debated and widely reported in the media, people either already feel sufficiently informed about scientific aspects of this topic, or have become alert to the difficulties entailed in its regulation.

Figure 18: The picture across Member States on what information people want about embryonic stem cell research



Ignoring the relative priority given to the issues, i.e. first or second choice, ten possible combinations of choices occur. Five combinations account for 78 per cent of all the choices made. As Table 6 shows, four out of the five frequent combinations include benefits and risks, accompanied by one of the other four topics. Combination 5 covers a group with an explicit interest in regulatory issues, including the question on 'who sets the moral limits.'

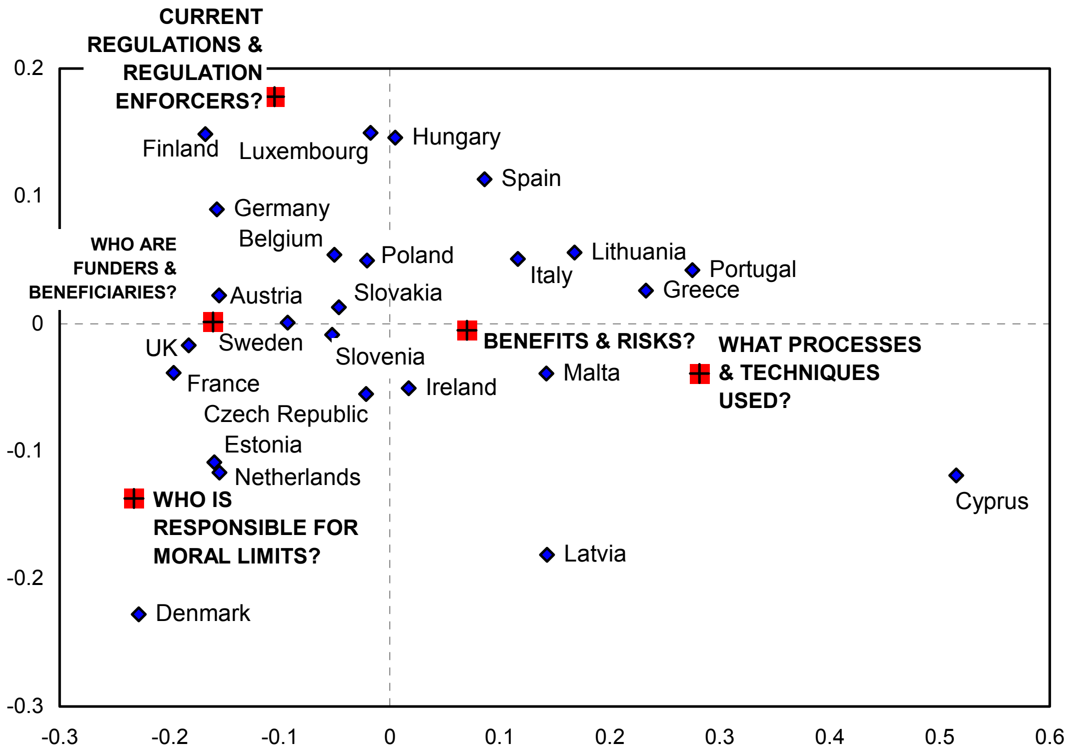
Table 6: The most frequent combinations of information

1. Benefits/risks & regulation	22
2. Benefits/risks & scientific processes/techniques	19
3. Benefits/risks & moral limits	18
4. Benefits/risks & funders/beneficiaries	10
5. Regulation & moral limits	9
6. Other combinations	22

The issue of who is responsible for setting moral limits may be taken as an interest in questions of regulation. Consequently, in addition to the interest in benefits and risks, a second major concern emerges: there is a strong concern for regulatory issues with regard to embryonic stem cell research. The combinations 1, 3 and 5 involve interest in regulatory issues, and amount to 49 per cent of all choices.

Figure 19 explores the variation in preferences for combinations of information across the EU, and is based on correspondence analysis. The figure tells us about *relative* associations, not absolute ones, identifying which countries are similar to each other in the responses given at the aggregate level. So, two points positioned close to each other are relatively more strongly linked with each other than with other points further away.

Figure 19: Clusters of countries with greater interest in particular topics



Because ‘benefits and risks’ are close to the centre of Figure 19, this shows that they are of general concern across all countries. At the bottom-left of the figure, we see Denmark, Netherlands and Estonia in a cluster that is relatively more interested in information on ‘moral limits.’ On the right-hand side of the figure, Greece, Portugal and Malta are a cluster relatively more interested in ‘processes and techniques.’ Finland, Luxembourg and Hungary are relatively strongly linked to ‘regulation’, and Austria, UK, France and Sweden are relatively strongly associated with the mention of ‘funders and beneficiaries’.

It may be concluded that when forming an opinion on embryonic stem cell research, European citizens tend not to consider it too important to be thoroughly informed about scientific details. It appears as though the public want to leave the esoterics of science to experts. They want to know about the consequences of technological developments – the risks and benefits – and whether regulations and ethical oversight is sufficient.

5. Governance, trust and information

5.1 The Governance of Science

In response to the tension between science and society, particularly evident in the controversies over GM food and crops, calls were made in the 1990s for greater public involvement in considerations of the social, ethical and legal implications of technological innovation. New European regulations (2001/18/EC) on the deliberate release into the environment of genetically modified organisms, stated that Member States shall 'consult the public and, where appropriate, groups, on the proposed deliberate release.' (Article 9)[vi]. Subsequently, some have argued in favour of 'upstream engagement' – bringing 'non-specialists' into decision-making on research agendas[9]. In the US a prominent member of the scientific community proposed that as research increasingly tackles value-laden issues, scientists should take a more inclusive approach and engage with society on the social, legal and ethical implications of science and technology[10].

What does the public think about the governance of science and technology; who should take the decisions and on what basis? In the survey, respondents were asked two forced-choice questions. First, should decision-making be left primarily to the experts or based mainly on the views of the public? And second, should decisions be made largely on evidence related to the risks and benefits or based on moral and ethical considerations?

Now, these two questions forced respondents to make a choice between the pairs of options offered; there was no scope for saying 'I would like to see scientific assessment informed by ethical and moral considerations', or 'I would prefer to have experts taking note of the public's views'. The intention of the question was to push respondents; when it comes to the crunch, in whom do Europeans have most confidence and what sort of evidence should be privileged?

The responses to the two questions allow us to divide the public into four 'types' reflecting different *principles of governance* (Figure 20). Opting for decisions based on expert advice rather than the views of the public, and on the grounds of scientific evidence rather than moral and ethical considerations is labelled the principle of *scientific delegation*. By contrast, those who want decisions to be based on scientific evidence and to reflect the views of average citizens are opting for the principle of s*cientific deliberation.* By the same token, those who would prefer decisions to be based primarily on the moral and ethical issues involved (rather than scientific evidence), and on the advice of experts rather than the general public, we refer to as adopting a principle of *moral delegation*. And those who prioritise moral and ethical over scientific considerations, whilst favouring the views of the general public over those of the experts, we label as adhering to a principle of *moral deliberation*.

Underlying these four principles of governance are beliefs about social progress and how science and technology should be organised towards that goal. Can experts and sound science remain the basis for deciding the direction of progress? Is science and technology developing along the right moral and ethical lines? Can experts be trusted to take account of the public interest?[11]

Figure 20: Segmentation of the European public on principles of governance

	Based mainly on the advice of experts	Based mainly on the general public's view
Based primarily on scientific evidence about the risks and benefits involved	Scientific delegation 59%	Scientific deliberation 9%
Based primarily on the moral and ethical issues involved	Moral delegation 17%	Moral deliberation 15%

While in the real world people might opt for a middle way, for example decisions based on scientific evidence informed by moral and ethical consideration, in our artificial either/or situation some 59 per cent of Europeans opt for scientific delegation. This could be taken as a vote of confidence in 'sound science'. Yet, 41 per cent are clearly concerned, opting for an alternative principle of governance. Nearly one in three Europeans want to see a greater reliance on moral and ethical issues and one in four want to see the public in the driving seat (deliberation) rather than experts (delegation).

Figure 21: Principles of Governance across Europe

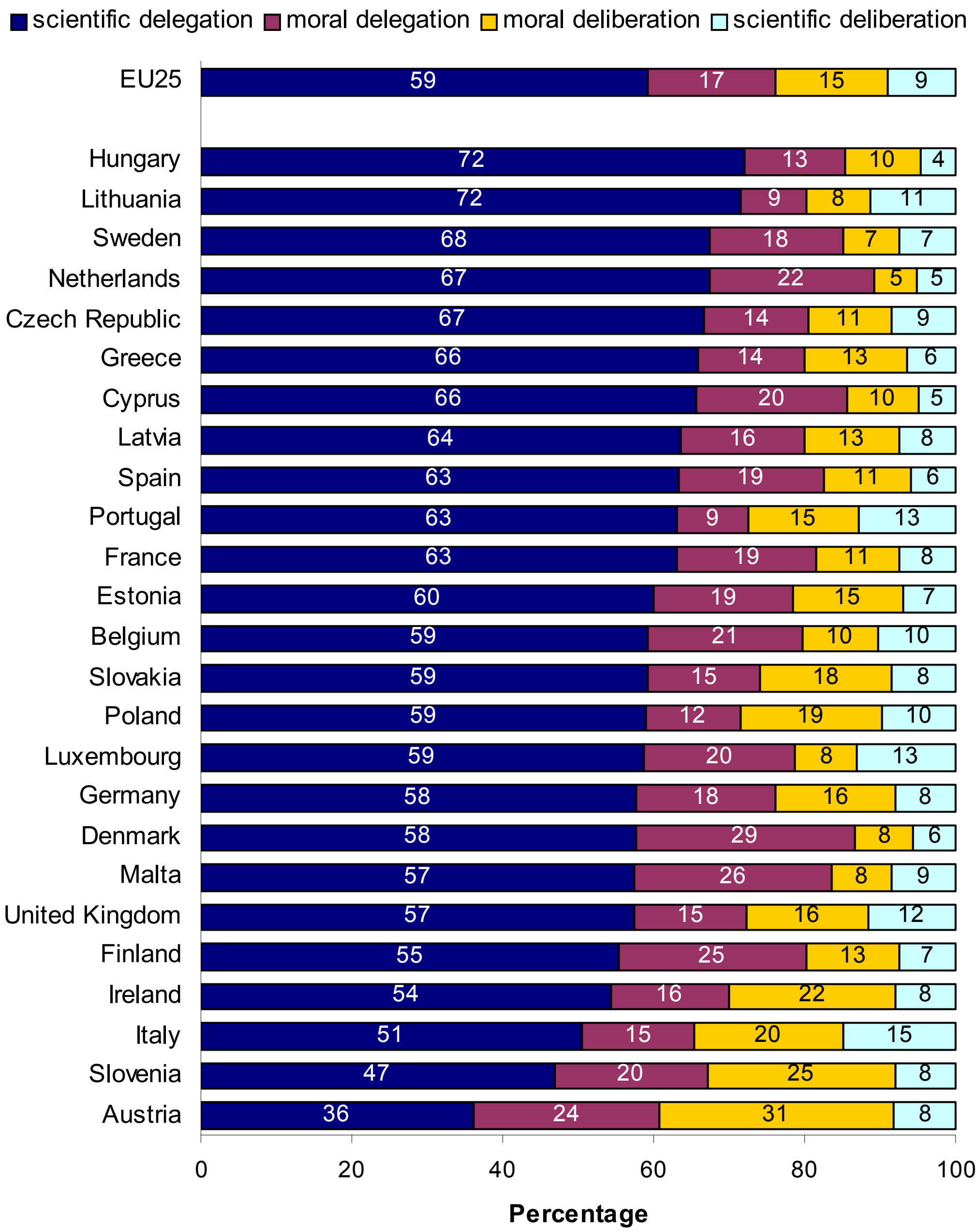


Figure 21 shows the variation in distribution of the four principles of governance across the EU. For example, scientific delegation gains the support of 72 per cent in Hungary, but only 36 per cent in Austria. It is also notable that in only two European countries, Austria and Slovenia, there is a minority supporting scientific delegation. In these countries a majority want to see moral and ethical considerations influencing decision taking, rather than scientific evidence. Other countries with relatively high support for moral delegation include Austria, Finland, Malta, Denmark and the Netherlands, while in Italy, Ireland, Poland and Slovakia there is relatively high support for moral deliberation. Support for scientific deliberation is relatively low, and only above 10 per cent in Lithuania, Portugal, UK and Italy; not much enthusiasm for up-stream engagement.

Table 7 shows how these principles of governance are related to both general and specific attitudes to science and technology. Column 2 looks at technological optimism (see Chapter 2) and shows that scientific delegation is associated with greater optimism about the contribution of science and technology to society, while moral deliberation is associated with the lowest level of optimism. Columns 3 and 4 compare the different principles of governance on support for GM food and for nanotechnology (see Chapter 3). On these two technologies scientific delegation is associated with the highest level of support, and moral deliberation with the lowest level of support.

Table 7: Principles of governance, technological optimism, and support for GM food and nanotechnology

	Mean score on technological optimism (additive scale 1-8, where 8 equals high optimism)	% who encourage GM food	% who encourage nanotechnology
Scientific delegation	5.1	35%	84%
Scientific deliberation	4.7	30%	77%
Moral delegation	4.7	25%	74%
Moral deliberation	4.3	24%	60%

5.2 Trust in key actors and in sources of information

To what extent do Europeans have trust and confidence in those involved in the system of science and technology and in those who mediate information to the public through television, radio, newspapers and magazines? To quote Luhmann, 'A system – economic, legal or political – requires trust as an input condition. Without trust it cannot stimulate supportive activities in situations of uncertainty or risk'[12]. This is surely true of the scientific and technological innovation, in which risk and uncertainty is unavoidable and where, on occasions, things do go wrong. People may wonder are these actors competent? are the sources credible? are they motivated by sectional interests or have they the public interest in mind?[13]

In the survey, respondents were asked:

> *'Now I'm going to ask you about some people and groups involved in the various applications of modern biotechnology and genetic engineering. Do you suppose they are doing a good job for society or not doing a good job for society?'*

Saying 'doing a good job for society' is likely to express a view that the actor is both competent and behaves in a socially responsible way. Thus, 'doing a good job' constitutes a proxy measure of trust and confidence. For those respondents who express a view, subtracting the percentage of respondents who say 'doing a good job' for those saying 'doing a bad job' provides an estimate of the relative levels of confidence in different actors.

Table 8: Trust in key actors and time-series trends

	% in 2005 (Base: including 'don't know's)		Trust surplus/deficit (Base: excluding 'don't know's)		
	Doing a good job	**Not doing a good job**	**1999**	**2002**	**2005**
Medical doctors keeping an eye on the health implications of biotechnology	75	8	72	80	79
University scientists doing research in biotechnology	73	8	-	73	78
Consumer organisations checking products of biotechnology	70	10	72	73	76
Scientists in industry doing research in biotechnology	64	15	-	55	60
Newspapers and magazines reporting on biotechnology	61	18	53	57	49
Farmers deciding which crops to grow	58	20	46	44	44
The European Union making laws on biotechnology for all European Union countries	54	19	-	48	42
Industry developing new products with biotechnology	53	21	-12	20	41
Television reporting on biotechnology	59	22	-	-	39
Environmental groups campaigning against biotechnology	50	24	54	56	35
Our government in making regulations on biotechnology	50	23	22	27	33
Shops making sure our food is safe	56	26	46	39	32

Table 8 is in two parts. Shown in the first two columns is the percentage of all Europeans saying 'good job' and 'not a good job' for each of the twelve actors. 'Don't know' responses are not presented in the table.

In the final three columns the confidence surplus or deficit is shown for 1999, 2002 and 2005. This is the difference between the percentages saying 'doing a good job' and 'doing a bad job'; a positive score denotes a trust surplus, while a negative score a trust deficit. For this calculation the 'don't know' responses are excluded, hence the index provides, for those Europeans who expressed an opinion, a relative ranking of levels of confidence for comparisons across actors and across time.

Looking at the percentages for 2005 (data columns 1 and 2) around 70 per cent of Europeans have confidence in doctors, university scientists, and consumer organisations. Around 60 per cent have confidence in scientists working in industry, and in newspapers and magazines. All the other actors – farmers, the EU, industry, television, environmental groups, government and shops – attract the confidence of between 50 per cent and 59 per cent of Europeans. Over the twelve actors involved in some way in biotechnology none has a confidence deficit in 2005, although around 20 per cent say that farmers, television, environmental groups, our government and shops are 'doing a bad job'.

The time series index – the trust surplus/deficit – from 1999 to 2005 is shown in columns 3-5. Broadly speaking doctors and consumer organisations retain a high trust surplus and farmers a moderate trust surplus. Shops show a consistent decline over the period. From 2002-2005 we observe small declines in the trust surplus in the EU (6 per cent) and newspapers (8 per cent), and a substantial decline for environmental groups (21 per cent). Both university and industry scientists show increases in the trust surplus of 5 per cent and industry moves from a deficit of –12 per cent in 1999 to a surplus of 41 per cent in 2002.

So, while those involved in research and development of biotechnology (scientists and industry) attract growing public trust, some of their critics in environmental groups appear to be losing the confidence of the public. Table 9 shows how the trust surplus/deficit for industry has changed across the EU15 countries and the scores for the ten new Member States for 2005.

Table 9 : Change in biotechnology industry's trust surplus deficit 1999-2005

%	1999	2002	2005
Finland	24	47	68
Spain	2	32	67
Netherlands	31	35	62
Belgium	9	22	61
United Kingdom	-16	29	58
Luxemburg	-10	18	56
Ireland	-30	17	46
Austria	-9	47	45
Denmark	-20	15	44
Portugal	31	33	41
France	-35	15	37
Italy	-32	-3	37
Greece	-38	23	31
Germany	3	20	20
Sweden	-46	-10	11
Cyprus			82
Czech Republic			77
Malta			75
Latvia			71
Slovakia			68
Lithuania			62
Estonia			61
Poland			54
Hungary			51
Slovenia			40

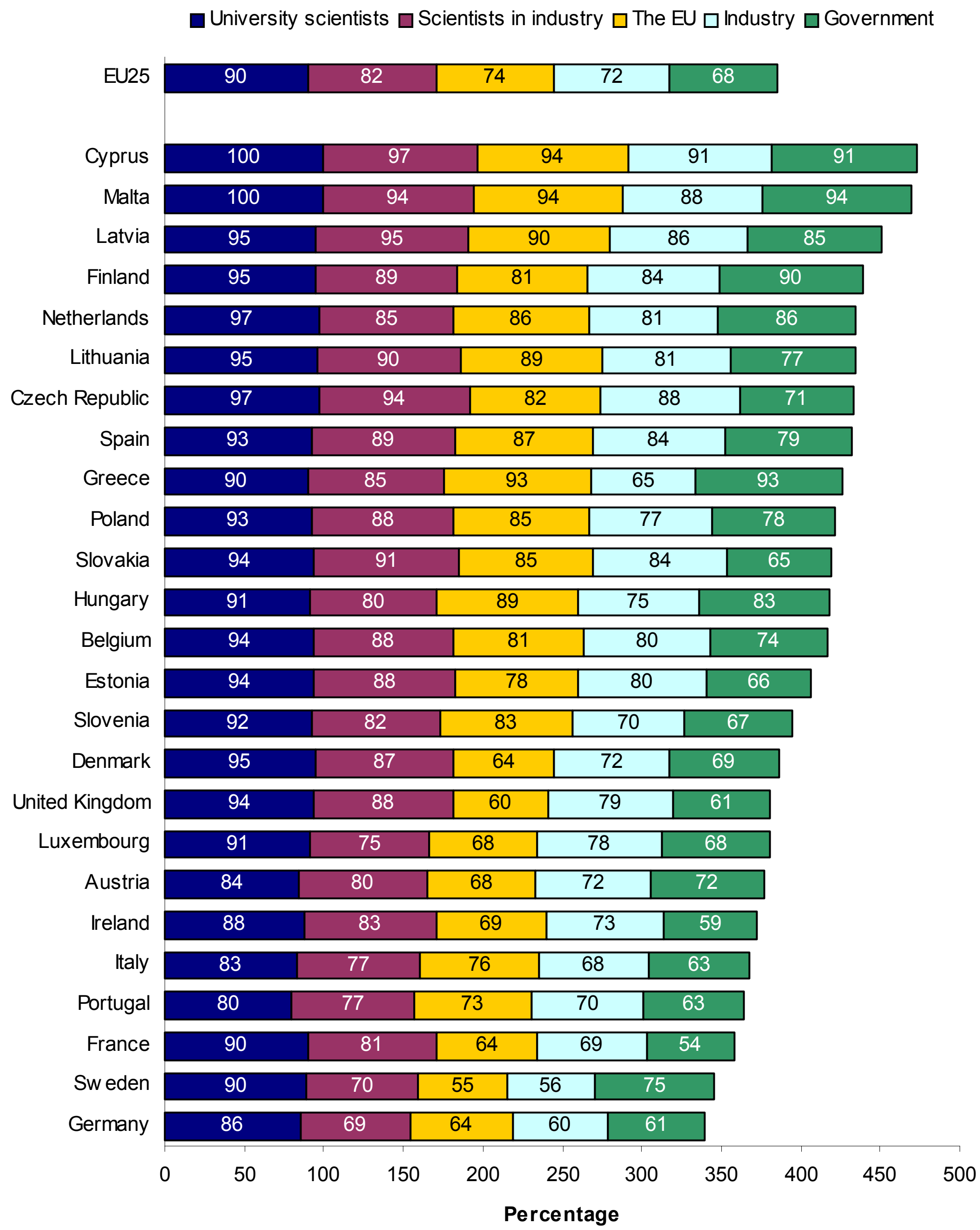
Looking at the EU15 countries, apart from Germany and Austria we observe consistent increases in the trust surplus for industry over the period 1999-2005. In fact, the change from 1999 to 2005 is remarkable, for example over 70 points in Ireland, UK and France, and between 60–70 points in Italy, Greece and Denmark.

With such consistent changes across Europe it seems implausible to attribute them to merely national conditions – a pan-European cause may be implicated. Could it be that in 1999 the term 'industry', like 'biotechnology', was associated in the public mind with the controversial agri-food technologies. From 2002 to 2005 agri-food biotechnologies became less and less newsworthy as a result of the de-facto moratorium and perhaps 'industry' became increasingly associated with bio-medical and industrial applications of biotechnology.

Across the ten new Member States, the trust surplus for industry is, with the exception of Slovenia at 40 points, in the upper half of the EU15 countries. Not surprising perhaps as, in the collective pursuit of economic progress, industry is likely to be seen as one of the key drivers.

Finally, in this section on trust, Figure 22 concerns the extent of public confidence in what might be called the ‘biotechnology system’. This comprises the actors that create and regulate biotechnology – research scientists, industrial scientists, industry and national and European regulators. First we observe high levels of trust (around 80 per cent plus) in university and industry researchers across the EU; the exceptions are Sweden and Germany. Second, in all the Member States with the exception of Austria, Denmark, Finland and Sweden, there is more confidence in the EU as a regulator than there is in respondents’ own country. And finally, many of the new Member States are amongst the most confident in the biotechnology system.

Figure 22: Public confidence in the ‘biotechnology system’



What conclusions can be drawn from these analyses? In the last few years it has been commonplace to hear discussions of the problem of trust and the need for ‘trust building’ in science and technology. Now if our question asking respondents whether they think particular actors are ‘doing a good job’, or ‘doing a bad job’ can be taken as a measure of trust, then there does not appear to be a crisis of trust in most EU countries. Without a time series extending back beyond 1999, we cannot tell whether the 1990s as a whole were times of particular scepticism in the ‘biotechnology system’, or whether 1999, coming at the end of four years of intensive controversy over GM food and crops, represents a nadir in public confidence. In this sense we can conclude that confidence has increased since 1999 but we cannot be sure whether it has merely returned to a similar level to the early 1990s.

5.3 Opinions about the uses of genetic information

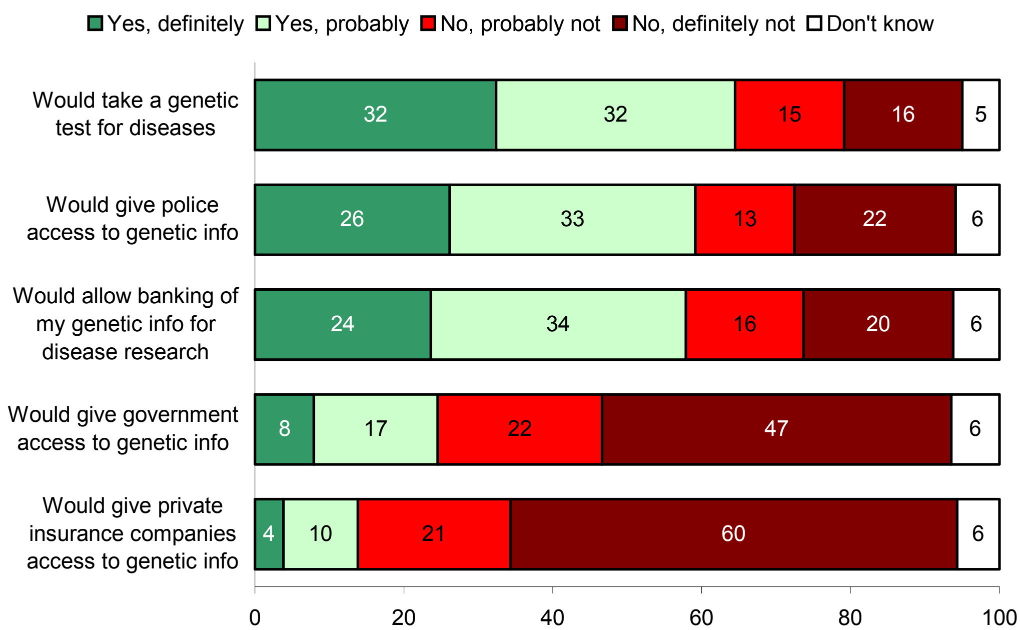
There is a debate between 'genetic exceptionalists' who argue that genetic information is sui generis and as such necessitates special regulation on informed consent and privacy to protect the individual, and others who see genetic information as functionally equivalent to other forms of information about the person[14,15]. Some ethicists are moving the debate towards the value position of communitarianism[16] – genetic information is a collective resource which, in research contexts, could be of benefit to wider society. Whatever the progress of this discussion the possible uses of genetic information in medical research, forensics, paternity disputes, life insurance, pharmacogenetics and nutrigenomics blur the boundaries between the patient and citizen, and between the individual and society. With the development of genetic databases in a number of countries for use in medical research and forensics, genetic information has become an issue in the public domain.

In the Eurobarometer respondents were asked *'would you be willing'*:

- *To take a genetic test to detect any serious disease that you might get?*
- *For your genetic information to go into a national data bank for research into the origins of diseases?*
- *For (appropriate government agency handling social security) to have access to people's genetic information?*
- *For private insurance companies to have access to people's genetic information?*
- *For the police to have access to people's genetic information to help solve crimes?*

Note the first two questions ask respondents for a decision about their personal genetic data, while the other three concern social uses.

Figure 23: Acceptability of uses of genetic data



While the two medically related uses – diagnosis of diseases and research into the origins of diseases – attract majority support, it is apparent that a sizeable minority is concerned about these medical uses of genetic information (Figure 23). 20 per cent say they would 'definitely not' be involved in a gene bank for research, and a further 16 per cent say 'probably not'. Almost the same percentage of Europeans are concerned about data banks for forensic purposes. For social security and, in particular, commercial insurance, the use of genetic information is widely seen as unacceptable.

Across Europe we find that a majority of people in Lithuania, Hungary, Greece, Germany and Austria say they would not allow their genetic data to go into a national data bank (Table 10).

Table 10: Acceptability of uses of genetic data across Europe

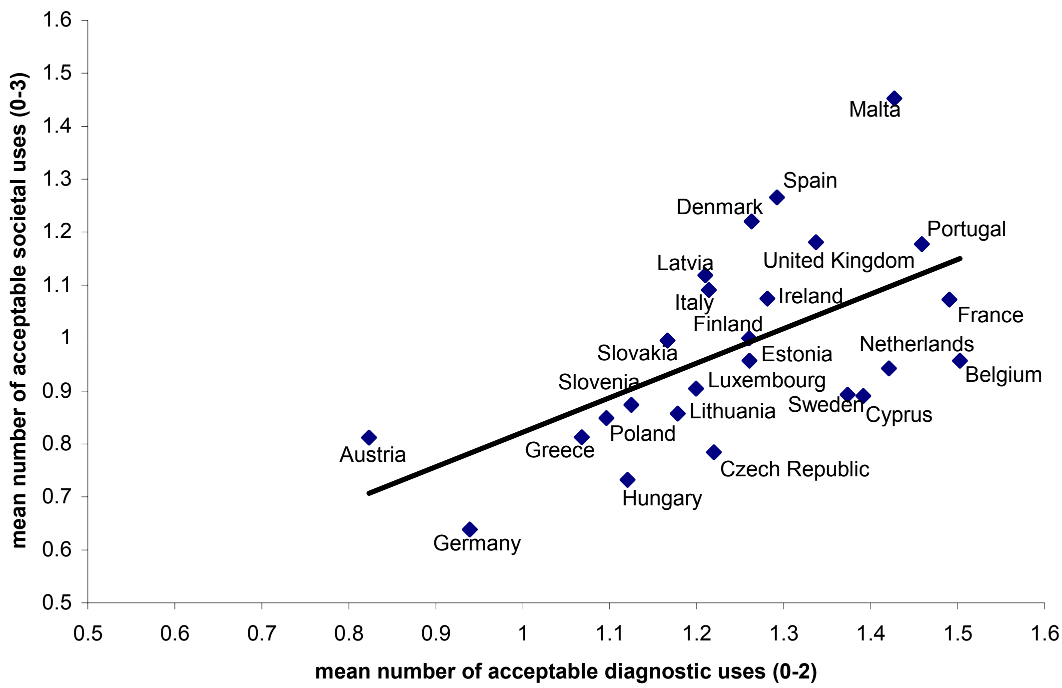
% responding 'Yes, probably' or 'Yes, definitely'	**Would take a genetic test for diseases**	**Would allow banking of my genetic info for disease research**	**Would give government access to genetic info**	**Would give private insurance companies access to genetic info**	**Would give police access to genetic info**
Belgium	81	69	22	9	65
Portugal	81	65	40	26	51
France	80	70	29	9	69
Malta	78	64	44	28	73
Cyprus	77	62	19	10	59
Lithuania	71	46	19	14	53
United Kingdom	69	64	27	19	72
Spain	69	61	55	21	50
Ireland	68	60	35	20	52
Latvia	67	54	31	16	64
Netherlands	66	76	12	7	76
Hungary	66	46	17	9	47
Czech Republic	65	56	11	9	58
Luxembourg	65	54	25	10	55
Slovakia	65	51	23	14	63
Estonia	65	61	25	11	59
Sweden	63	74	12	4	73
Greece	63	44	31	16	34
Italy	62	60	28	25	56
Slovenia	62	51	31	20	37
Poland	59	51	14	10	61
Finland	58	68	25	9	66
Germany	52	42	9	5	50
Denmark	50	76	40	6	76
Austria	45	37	19	13	49
Total EU25	64	58	25	14	59

The five uses of genetic data fall into two clusters. The first cluster is disease and diagnostic related – genetic tests for serious diseases and genetic data banks for research into diseases – which people may or may not believe are, like personal health records, subject to confidentiality. We label this cluster 'diagnostics'.

In the second cluster are uses of genetic information in the societal domain: testing for forensic purposes, social security and insurance, which we will call 'societal'. To compare the relative acceptability of the diagnostic and societal uses of genetic information we count the number people saying 'yes, definitely' and 'yes, probably' to the two disease related uses (giving a scale of 0-2) and separately to the three societal uses (giving a scale of 0-3).

There is a strong correlation between the level of acceptability for the diagnostic and societal uses of genetic information (Figure 24). In other words, countries where more people consider the use of genetic information for medical diagnosis and research to be acceptable, are very likely to be countries where more people also consider societal uses to be acceptable.

Figure 24: The acceptability of diagnostic and social uses of genetic data



Countries giving relatively more support to uses of genetic testing in general – in the top right hand side of the figure – include Spain, UK, Malta, Denmark and Portugal. In all these countries there is support for both diagnostic and societal uses. Towards the bottom left hand side of the figure are Germany, Austria, Greece, Hungary and Czech Republic. In these countries there is relatively less support for either diagnostic or societal uses of genetic information.

Countries that are more inclined to support diagnostic uses than societal uses include France, Belgium, Netherlands, Sweden and Cyprus.

Taken as a whole these results suggest that the European public is supportive, but not overwhelming so, of the use of genetic data for medical diagnosis and research. Forensic uses attract about the same level of support as medical research and other societal uses are rather strongly opposed. Interestingly, in the Nordic countries – Sweden, Finland, Denmark, and Netherlands – more people would agree to allow their genetic data to go into a national bank for research, than would take a genetic test themselves. Is this evidence for the communitarian ethic? – that is, more interest in supporting the 'other' than benefiting oneself. If the findings can be construed in this way it suggests that the success of attracting participation in gene banks may be more a cultural tendency than a personal decision.

The common theme in this chapter is the issue of trust and confidence. We find that a majority of Europeans opt for the principle of scientific delegation – decisions taken by experts on the basis of the scientific evidence. However, a substantial minority want to see moral and ethical issues given more emphasis and the public voice taken into account. To build further confidence in science policy it would seem prudent to ensure that moral and ethical considerations and the public voice(s) are seen to inform discussions and decisions.

The survey data do not support the claim that there is a crisis of trust in actors involved in biotechnology in Europe. Trust in university and industrial scientists, and in industry itself show substantial improvements since 1999. The European Union is more trusted than respondents' national government in the regulation of biotechnology and on the reporting of biotechnology, newspapers and magazines are trusted more than television. Finally, support for genetic data banks cannot be taken for granted. Are those responsible for developing genetic data banks doing enough to cultivate public trust?

6. Engagement & knowledge

6.1 Knowledge about biotechnology

In the survey, people were presented with a series of items that were designed to tap the extent of their knowledge about biology and genetics. Respondents were invited to say whether they thought a statement such as 'yeast for brewing beer or making wine consists of living organisms' was true, false or that they did not know the answer. Ten such items (a sample from the many questions we could have asked) were included in the survey. By adding up the number of correct answers given, each respondent can be assigned a score ranging from zero to ten, which acts as an overall indicator of knowledge.

Figure 25 (page 57) shows the ten quiz questions presented to respondents. The items are ordered by the proportion of people giving 'don't know' answers, with those questions attracting the fewest 'don't know' answers at the top. Approximately three quarters of Europeans know that Down's syndrome can be detected in early pregnancy. Just under 70 per cent know that yeast for brewing beer or wine consists of living organisms. A similar proportion know that cloning produces genetically identical copies. Sixty per cent believe that more than half of human genes are identical to those of chimpanzees while fifty per cent know that embryonic stem cells can develop into normal humans. However, only 34 per cent reject the idea that human cells and genes function differently from those in animals and plants (Q9) – hinting at an assumption of human genetic exceptionalism.

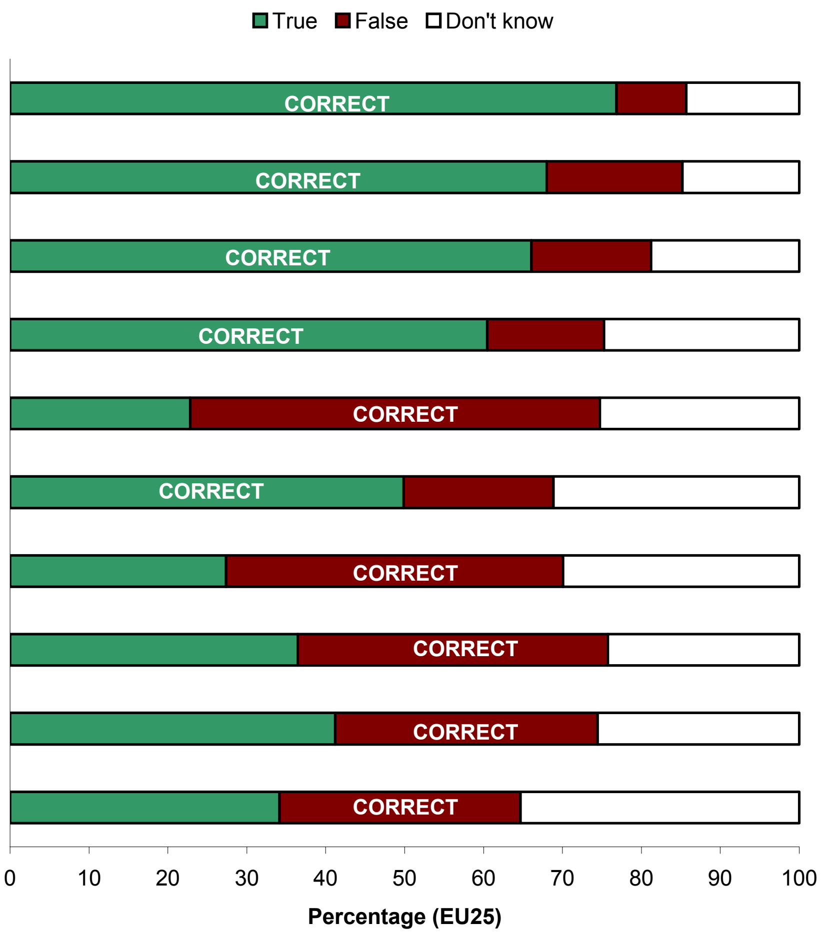
While seven of these questions concern 'text book' knowledge, dealing with matters of fact that one might learn in formal or informal education, questions 5, 7 and 8 are of a different category. These three questions tap into what we call menacing images. While there is a positive correlation between people's scores on the text book and image questions, the latter deserve particular attention. The three image questions were formulated in 1996 and they were based on what we heard in focus group discussions with members of the public. Thus people said words to the effect that:

- '*Ordinary tomatoes don't have genes but genetically modified ones do*'
- '*By eating a genetically modified fruit, a person's genes could also become modified*'
- '*Genetically modified animals are always bigger than ordinary ones*'

Now, while agreement to these propositions indicates an absence of knowledge about genetics, it also shows an inclination to assent to the idea that food biotechnology is associated with fears about adulteration, infection and monstrosities[17]. Such concerns echo the idea of magical thinking, described by the anthropologist Fraser and more recently Rosin[18]. For example, and paralleling question 5, the consumption of chicken slumped for a time when people heard that bird flu had reached Europe even though one cannot catch bird flu from properly cooked chicken. This is an example of the law of contagion, the transfer of essences, 'once in contact, always in contact'.

That about 25 to 35 per cent of Europeans assent to these menacing image propositions does not necessarily mean that they all held such views before being asked the question in the interview. In all probability many would not have come across the issue before. But when the question is posed, people try to make sense of it. Perhaps a combination of their unease about the technology, anxieties about food and magical thinking lead them to assume the worst.

Figure 25: Knowledge about biology and genetics



	% Correct			
	1996	1999	2002	2005
It is possible to find out in the first few months of pregnancy whether a child will have (Down's Syndrome, trisomy, Mongolism)	81	79	79	79
The cloning of living things produces genetically identical copies	46	64	66	68
Yeast for brewing beer or making wine consists of living organisms	68	66	63	65
More than half of human genes are identical to those of a chimpanzee	51	48	52	62
By eating a genetically modified fruit, a person's genes could also become modified	48	42	49	54
Embryonic stem cells have the potential to develop into normal humans	n/a	n/a	n/a	51
Genetically modified animals are always bigger than ordinary ones	36	34	38	45
Ordinary tomatoes do not contain genes, while genetically modified tomatoes do	35	35	36	41
Human cells and human genes function differently from those in animals and plants	n/a	n/a	n/a	34
It is not possible to transfer animal genes into plants	27	26	26	31

6.2 How has knowledge changed over time?

The Eurobarometer surveys provide time series data on some of the quiz questions asked in 2005. Eight of the ten asked in 2005 have been included in surveys going back to 1996. Hence we can look at almost a decade of continuity or change in fifteen European countries. Figure 25 shows the percentage of correct answers for each of the time series knowledge items over four waves of the Eurobarometer survey series. In order to maintain comparability, data from the ten new Member States in 2005 are excluded from the figures.

Looking down Figure 25, responses to two questions have hardly changed between 1996 and 2005 (the statement about Down's syndrome, and the statement about yeast). All of the other questions, which concern genetics more directly, show small increases in correct responses. And there has been a striking increase in the proportion of Europeans' understanding of cloning producing genetically identical offspring, from 46 per cent in 1996 to 68 per cent in 2005. The small upward trend in the genetics items, contrasted with stability in the other questions, provides some evidence that Europeans' knowledge of genetics and biotechnology has increased over the past decade. This may be as a result of a new generation of young people having been taught these topics at school, or it may be that the population as a whole is learning more about these emerging areas. More detailed analysis in the future will be required to adjudicate between these two potential explanations.

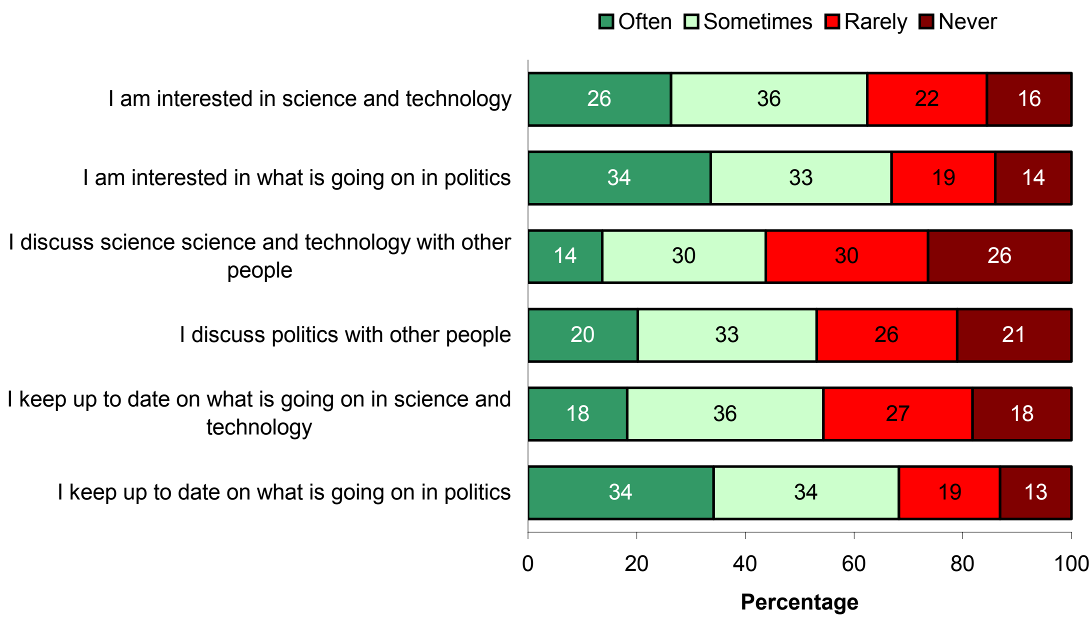
6.3 Interest in Science and Technology

The Lisbon Strategy aims to make the EU the most competitive and dynamic knowledge-driven economy by 2010. In order to meet this goal, it could be argued that it is important for European citizens to take an interest in various aspects of science and technology. But, in recent years, the public interest – or lack of interest – in science and technology has been of concern, leading to actions to encourage young people to pursue careers in science and technology, to popularise science and technology and to engage European publics in discussions about science and technology.

In the survey, people were asked the extent to which they feel interested in, keep up to date with, and discuss science and technology. Similar questions were posed about politics. A majority of the European public say they are 'often' or 'sometimes' 'interested in science and technology' and 'keep up to date with what is going on in science and technology' (Figure 26). 44 per cent of the respondents say they 'often' or 'sometimes' 'discuss science and technology with other people'.

Attentiveness to politics is higher considering the level of interest, efforts to keep up to date, and the inclination to discuss with other people, but the difference is quite modest. The main difference between attentiveness to 'politics' and 'science and technology' among European citizens is in keeping up to date. 34 per cent of the respondents agree with the statement 'I keep up to date on what is going on in politics', compared with only 18 per cent on the issue of keeping up to date with science and technology, a reflection perhaps of the greater coverage of politics in the media compared to science.

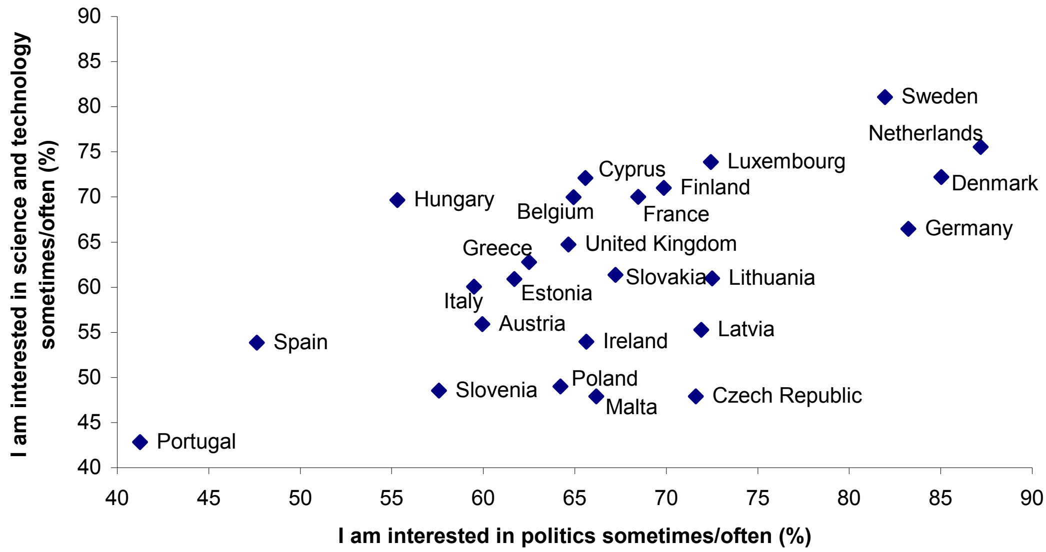
Figure 26: Interest in science and technology, and in politics



In modern societies, many people are faced with an overload of issues and information. It might be thought that the general conflict between the availability of time and a growing array of public issues would mean that 'politics' and 'science and technology' are competing subject areas. Hence, if a person takes a high level of interest in politics, this would imply a lower level of interest in science and technology. However, there is no indication of an 'issue trade-off' in the sense that interest in science and technology is at the expense of interest in other issues, such as politics. In fact, there is a moderate positive correlation of 0.4 between responses to the 'interested in politics' and 'interested in science and technology' items across individuals in the survey. It seems that these interest areas might mutually enforce each other, and that interest in science and technology may be an expression of a general involvement in societal issues at large.

In Figure 27 below, we see that the same positive correlation applies at the aggregate level amongst the 25 Member States. Each country is plotted according the percentage of its citizens reporting interest in science and technology on the vertical (Y) axis, and interest in politics on the horizontal (X) axis. The upward slope in the plot shows the positive relationship. We can say, then, that it is not only that individuals who are interested in science and technology are also likely to be interested in politics, but that in countries where many are interested in science and technology, there are many also interested in politics.

Figure 27: Interest in politics and in science and technology

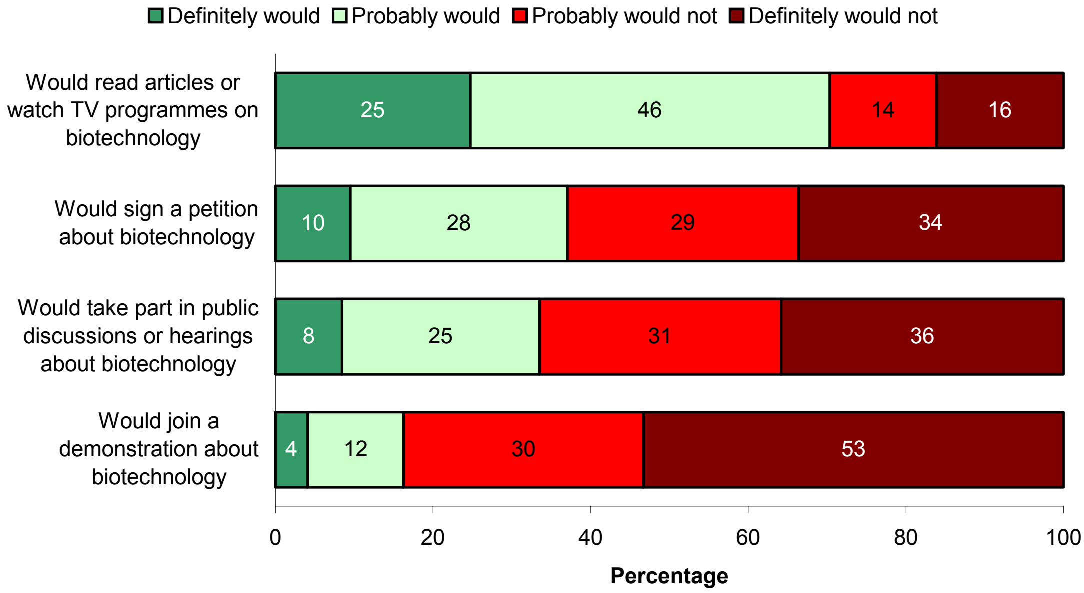


6.4 Participation in issues concerning biotechnology

Some Europeans have taken an active part in the debates on biotechnology. For example, in 1997, Austrian non-governmental organisations and public protesters launched a *Volksbegehren* – a non-binding petition to Parliament – to ban GM food, the release of GMOs, and patents on genes. Over one million citizens signed the petition. In 1996, a cargo of US genetically modified soybeans arriving in Aarhus triggered public demonstrations and heated public debate in Denmark. In 2003, some 30,000 citizens participated in the UK 'GM Nation?' debate. In 1999, Dutch citizens formed citizens' panels to take part in a wider technology assessment process concerned with the issue of cloning. And in 2002, German citizens engaged with scientists in joint scenario-building on 'The limits of genes, money, and scientists'. These are just a handful of examples among many on how European citizens might actively take part in issues related to biotechnology.

In the survey, people were asked how likely they would be to take part in different activities concerning biotechnology. The questions included information-oriented activities such as watching television programmes on the advantages and disadvantages of biotechnology and policy-oriented activities such as signing petitions and joining demonstrations about biotechnology. Figure 28 shows the response distributions for these questions. 71 per cent of the European public 'definitely would' or 'probably would' read articles or watch TV programmes on biotechnology, 38 per cent would sign a petition, 33 per cent would take part in public discussions or hearings, and 16 per cent would join a demonstration about biotechnological issues.

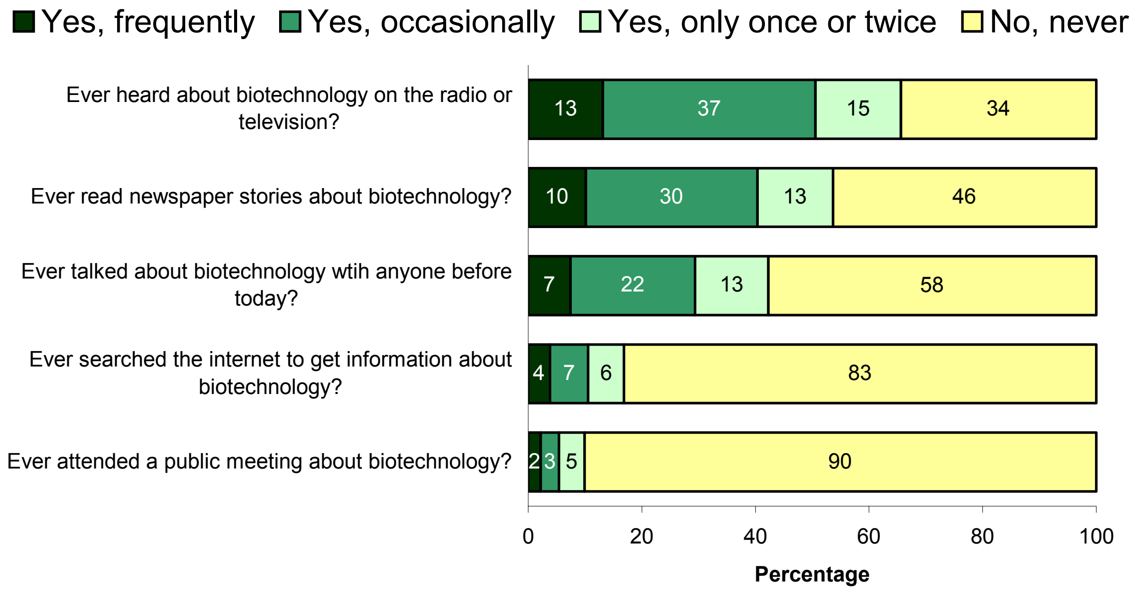
Figure 28: Participation in issues concerning biotechnology



Of course, in a survey there is no cost to agreeing that one might actually do something but these results indicating *intended* behaviour are suggestive of the potential for biotechnology to mobilize the public. To examine this notion in more detail, respondents were asked about their past involvement in a number of activities relating to biotechnology. The response categories for these questions were: 'yes, frequently', 'yes, occasionally', 'yes, but only once or twice', and 'no, never'.

Figure 29 indicates that a majority of Europeans report having heard about biotechnology on TV or radio and having read newspaper stories on the topic. 42 per cent had talked about biotechnology with someone prior to the interview, 17 per cent have searched the internet to get information about biotechnology, and 10 per cent say that they have attended a public meeting about biotechnology.

Figure 29: Participation in issues concerning biotechnology

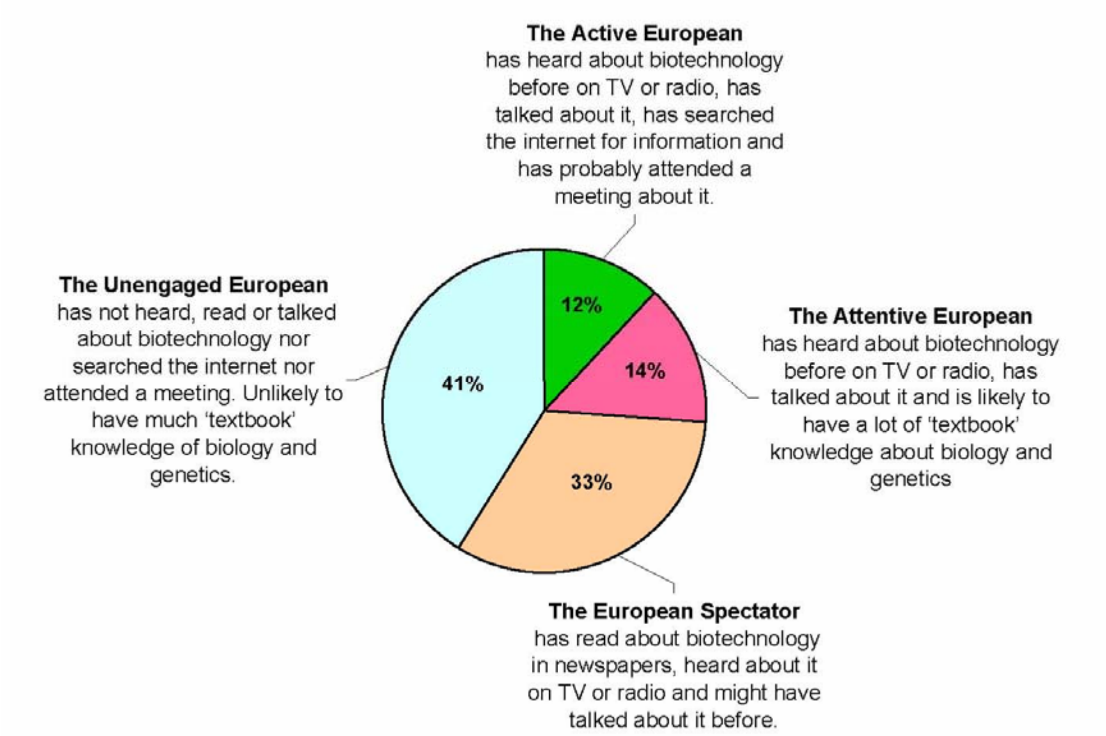


6.5 Modes of engagement with biotechnology

Scientific knowledge and participation in activities related to biotechnology are both dimensions of what we call 'modes of engagement' with biotechnology. In combination, they provide a useful picture of the range of practices by which citizens engage in biotechnology. Using latent class analysis (which groups together respondents who give similar combinations of answers) we empirically identify four dominant modes of engagement among European citizens.

In essence, what we have done is to divide the European public into four discrete groups of citizens on the basis of their responses to the questions about participation and knowledge.

Figure 30: Four modes of engagement with biotechnology



The mapping of groups is shown in Figure 30. The pie chart shows the estimated proportions of citizens in each of them. We have labelled the four groups: 'active', 'attentive', 'spectator' and 'unengaged'. The text beneath each of the group labels in Figure 30 describes the response profile of the 'typical' member.

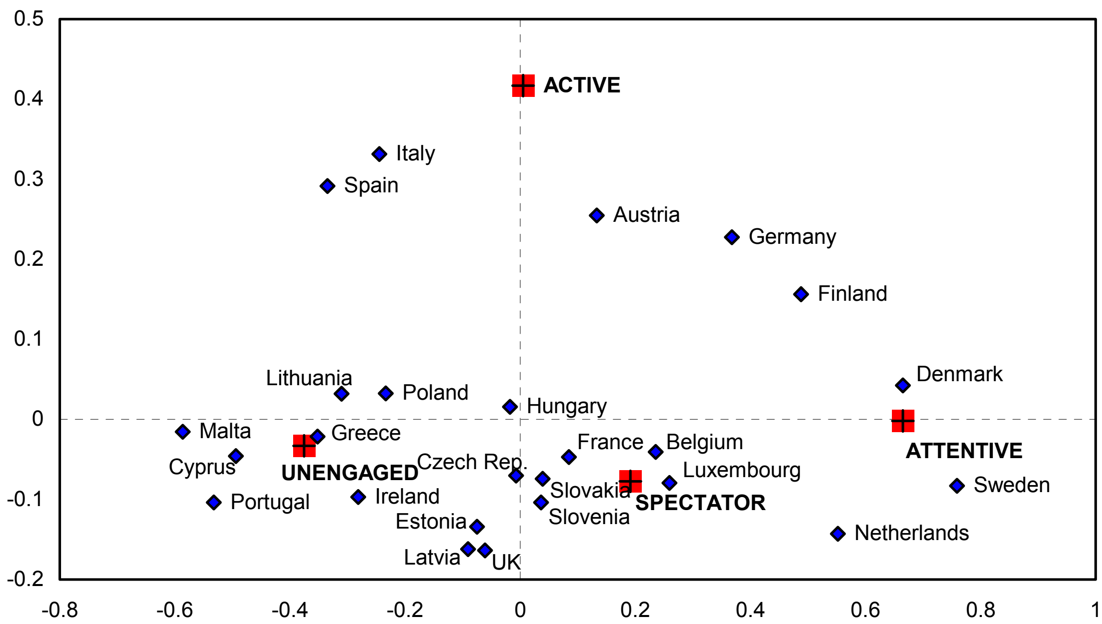
The pie chart shows that there are two large groups that between them encompass around three quarters of the European population. The largest is the unengaged group. Around 40 per cent of Europeans fall into this category and the typical member reports not having heard, read or talked about biotechnology before the survey interview. The 'unengaged' European has almost certainly not searched the internet for information nor attended a public meeting and is also very unlikely to be well informed about biology and genetics. The other large group is composed of people who are likely to have heard and read about biotechnology. The typical 'spectator' may possibly have conversed about biotechnology at some point before the survey interview was carried out.

The two remaining groups each account for between ten and fifteen per cent of Europeans. One group is characterised by attentiveness to biotechnology, including conversation and media exposure. The 'attentive' Europeans are also the only ones that tend to be highly knowledgeable about biology and genetics. Finally, the typical 'active' European has heard and talked about biotechnology, has searched the internet for information about it and has probably attended a public meeting concerning biotechnology. Interestingly, this typology suggests that the most highly participative of European citizens do not necessarily have the highest textbook knowledge. This is more likely to reside with the 'attentive' Europeans – who take an active interest but one which does not include serious information seeking and organised deliberation. Hence we cannot say that there is a simple relationship between knowledge and active engagement in biotechnology.

In Figure 31 below, which shows the results of a correspondence analysis, each EU country is positioned in a map reflecting the relative strength of the different modes of engagement. The four modes are represented by the red squares. We find that the Nordic and Dutch populations are situated close to the 'attentive' point in the diagram. In these countries, we expect citizens to have a high level of text-book knowledge of biology and genetics, watch TV and read newspaper articles on biotechnology, and talk with other people about biotechnology.

Closer to the 'active' point are Italy, Spain, and Austria, where active involvement in public meetings and use of the internet would happen more often, while the level of text-book knowledge would be somewhat lower. Slovakia, Slovenia, France, Belgium, and Luxembourg come closest to the 'spectator' point. In these countries, we would expect to find high proportions involved in following stories on biotechnology in the media, perhaps talking to other people about biotechnology, but generally neither too actively involved nor very knowledgeable concerning biology and genetics. In countries such as Greece, Ireland, Lithuania, Poland, Cyprus, Malta, and Portugal, who are all close to the 'unengaged' point in the chart, text-book knowledge as well as involvement in any activities would tend to be lower than in other countries.

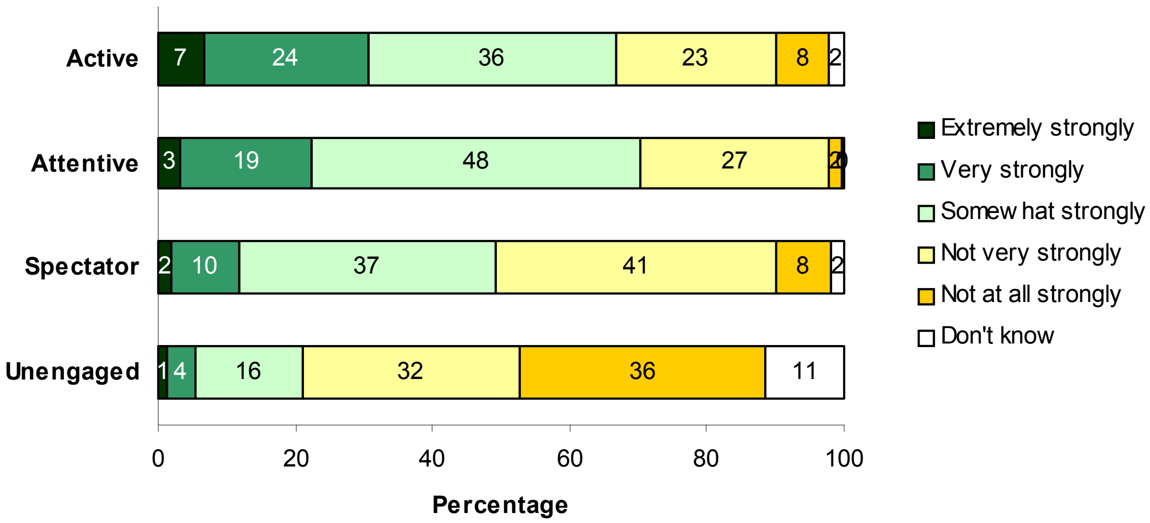
Figure 31: Clusters of countries and modes of engagement



6.6 How do groups differ in other ways?

The mode of engagement that citizens employ is correlated with their overall concern about biotechnological issues. At the end of the interview, each respondent was asked how strongly he or she felt about the issues concerning biotechnology raised during the interview. The 'active' citizens generally have the strongest feeling of concern over biotechnology (Figure 32). 31 per cent of this group state that they feel 'extremely' or 'very' strongly about the issues raised during the interview. 22 per cent of the 'attentive' citizens and 12 per cent of the 'spectator' citizens feel equally strongly about biotechnological issues. Only 5 per cent of the 'unengaged' citizens have 'extremely' or 'very' strong feelings about biotechnology.

Figure 32: Engagement and 'How strongly do you feel about these issues'



This result reflects the association between the degree to which citizens perceive biotechnology to be a significant issue *for* their lives on the one hand and the strategies that citizens employ to deal with these issues *in* their lives on the other hand. The 'active' Europeans practically translate their significant concern with biotechnologies into involvement in a broad variety of activities, whereas the 'unengaged' Europeans, in comparison, feel less concerned about the biotechnology issue and remain relatively passive.

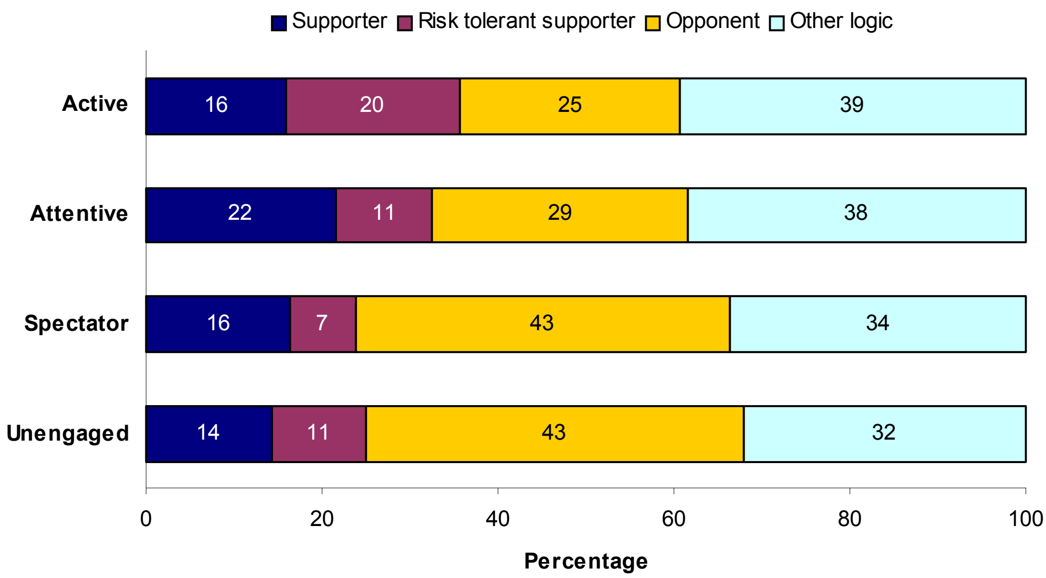
How do people's modes of engagement relate to their attitudes towards the governance of science and technology? Table 11 shows that the 'attentive' Europeans are most in favour of scientific delegation, decisions concerning science and technology based on an assessment of risks and benefits and made by experts rather than the general public. 68 per cent of the 'attentive' citizens thus support the 'scientific delegative' principle of science and technology governance, whereas only 9 per cent of the 'attentive' public supports the reverse 'moral deliberative' principle by which decisions should be made by the general public on the basis of moral and ethical concerns. In comparison, 21 per cent of the 'active' Europeans take a 'moral deliberative' standpoint and 53 per cent support a 'scientific delegative' principle of governance.

Table 11: Principles of governance and modes of engagement

	% Spectator	% Unengaged	% Attentive	% Active
Scientific delegation	62	55	68	53
Scientific deliberation	8	10	8	9
Moral delegation	17	17	15	17
Moral deliberation	13	17	9	21

Turning to the relation between modes of engagement and attitudes towards technologies, we find that that the 'attentive' and 'active' Europeans are most optimistic about the ability of technologies to improve our way of life in the future. The 'unengaged' public is least optimistic in this regard. Furthermore, interesting nuances appear when we look at the particular logics of support and opposition towards specific applications of biotechnology. Figure 33 below shows the logics of support and opposition to GM food among the respective engagement groups.

Figure 33: Logics of support / opposition towards GM food



Among the 'spectator' and 'unengaged citizens the opposition to GM food is high. 43 per cent of the 'spectators' and 43 per cent of the 'unengaged' citizens are in opposition to GM food, compared to only 29 per cent of the 'attentive' citizens and 25 per cent of the 'active' citizens. The 'active' and 'attentive' Europeans are most supportive of GM food, yet there is an obvious difference between the two groups. The 'active' Europeans are more likely to be concerned about the risks involved in GM food, even if they think that this application of biotechnology should be encouraged. Hence, they resemble more closely the risk tolerant supporters, whereas the 'attentive' public is less focused on the risks of the application. The sensitivity towards risk among the 'active' Europeans runs through all the technologies assessed in the survey.

7. Europe of tomorrow: young people and science

Some European countries report that fewer students at school and University are taking courses in scientific subjects. At a time of proposed expansion in research and development and the goal of Europe to become a leading 'knowledge economy', this trend is of concern. Does it indicate a broader disenchantment with science among younger people?

Moreover, are the values held by young generations a 'cultural mirror image of the future'? It is not clear whether the attitudes and values people develop in their youth will be sustained through later phases of their lives, or whether people, as they age, leave such youthful values behind and 'grow into' more or less the same values as the generation before them. When we see a difference in attitudes between the young and old in surveys such as the Eurobarometer, should we interpret it as a generation effect or as a life-cycle effect? The answer is not 'either–or', but 'both–and'. Some values are characteristic of the particular phase of life; they will change as young people grow older. Other values are connected to the generation; they will influence people for the rest of their lives.

In this chapter, we describe some distinctive characteristics of the young Europeans. Respondents are categorised into four age groups: 15-25 years, 26-45 years, 46-65 years, and 66 years and above. In the weighted EU25 sample, these age groups represent respectively 17, 36, 29 and 18 per cent of the total sample. A particular focus of this chapter is not on age group *similarities* – there are a good number of these. Rather, we concentrate on differences, drawing attention to questions that are most pertinent for telling the age groups apart.

7.1 Technological optimism and pessimism

As reported in Chapter 3, the Eurobarometer asked respondents whether they thought a range of technologies would improve our way of life in the next twenty years, whether they would have no effect, or whether they would make things worse. Chapter 3 reported that general optimism in technology is widespread across Europe: with only a few exceptions, most people believe that developments in the various technologies will improve our way of living. The exceptions are nuclear energy, space exploration and nanotechnology: Europeans seem more sceptical about nuclear energy, they are not convinced about the benefits of space exploration, and many say that they do not know whether nanotechnology will improve our way of life or not.

How does this picture look when studied for the four age groups separately? Are the younger more optimistic or pessimistic than the older groups?

In general, youth tends to be associated with optimism about technological developments. Figures 34 and 35 show responses to two technologies that illustrate the two general patterns found.

Figure 34: Age and optimism about biotechnology

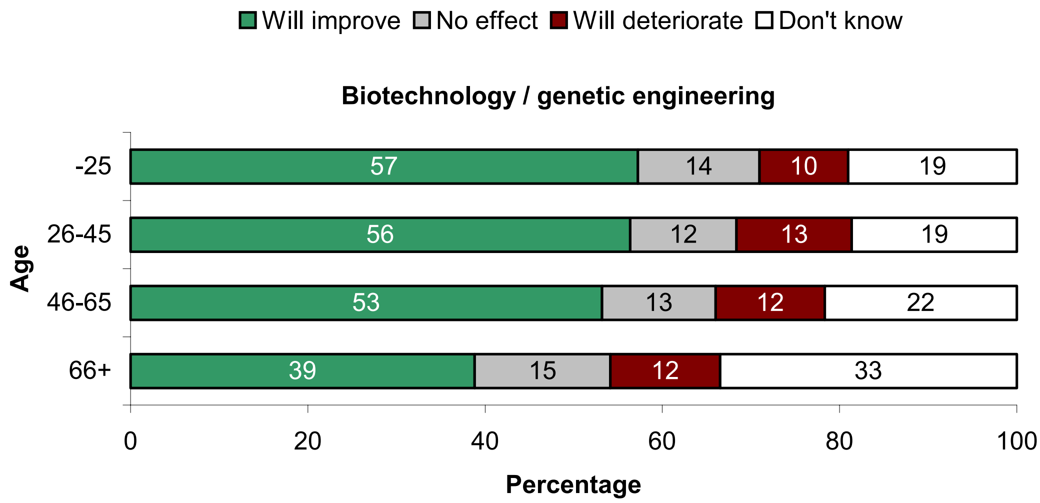


Figure 35: Age and optimism about mobile phones

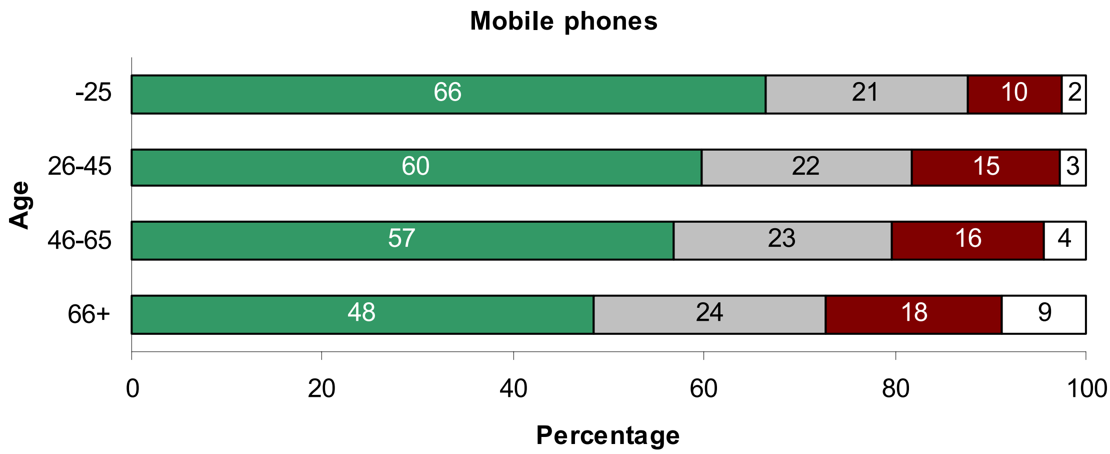


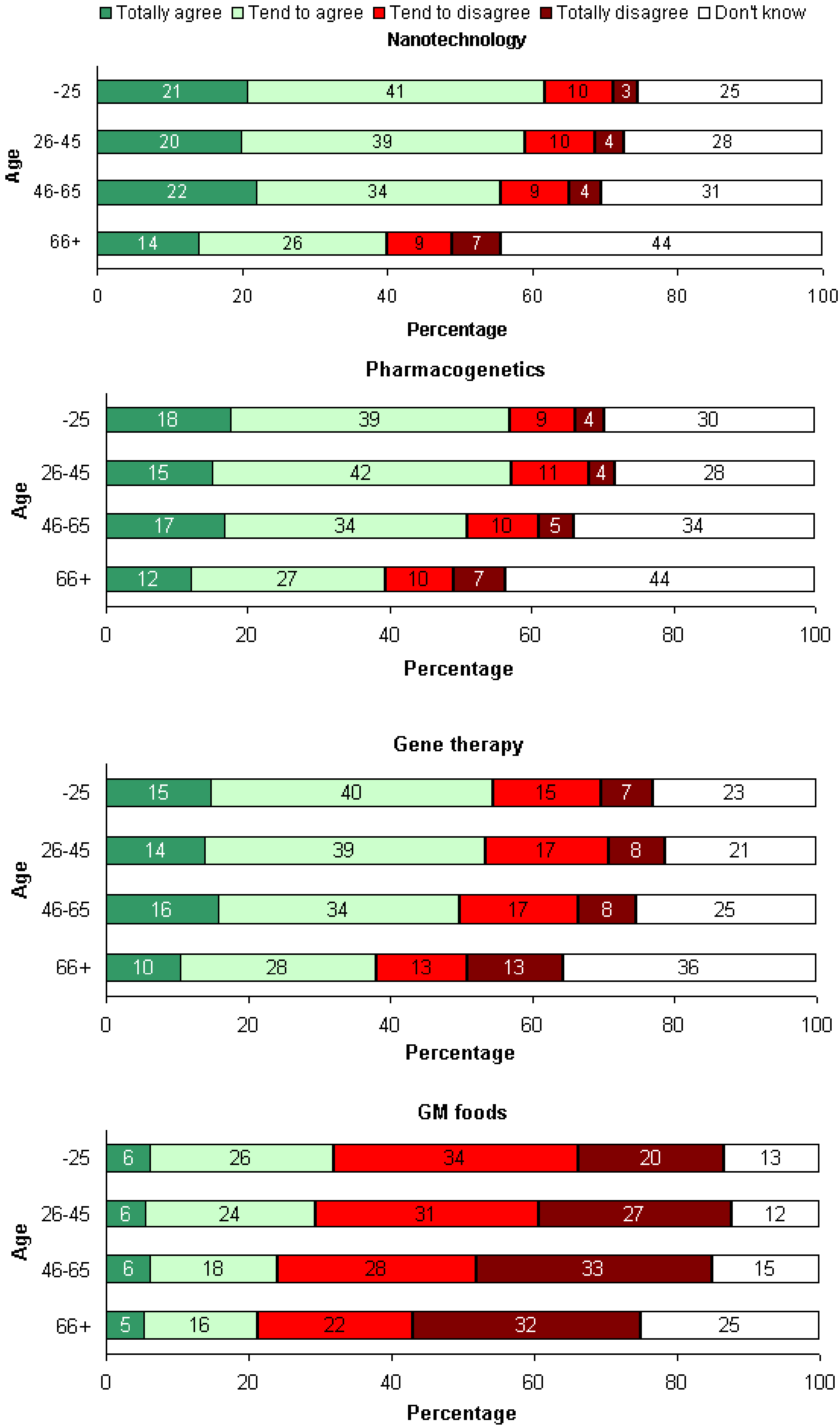
Figure 34 illustrates the first trend. For many of the technologies, the response pattern of the youngest age group does not differ greatly from the patterns of the two mid-age groups. Biotechnology is one example of this, but other examples are solar energy, nanotechnology, nuclear energy and wind energy. The greatest difference here is between the 66+ year-olds and the rest.

Figure 35 illustrates the second trend. With space exploration, computers and information technology, and mobile phones, we see a gradual decrease in optimism with increasing age. However, it should be noted that alongside this apparent decrease in optimism we often observe a greater propensity amongst the 66+ year-olds to give a 'don't know' response.

With reference to biotechnology, the main concern of this survey, older people are less likely to express an optimistic attitude than younger people. But we should not draw the conclusion that the older age group is more *pessimistic* than the other age groups. For biotechnology, 39 per cent of respondents in the 66+ age group respond ‘don’t know’ – a markedly higher rate than for other age groups. Moreover, the percentage who say ‘will deteriorate’ is markedly similar to the percentage of people in the other age categories saying the same thing. So it may not be fair to say that the older respondents are more pessimistic than the young; instead they might find it difficult to tell how the developments will influence our future lives.

Further insight can be gained by turning to another set of questions in the survey. Respondents were asked whether they believed that different technologies should be encouraged (see Chapter 4). Figure 36 shows the results broken down by age group.

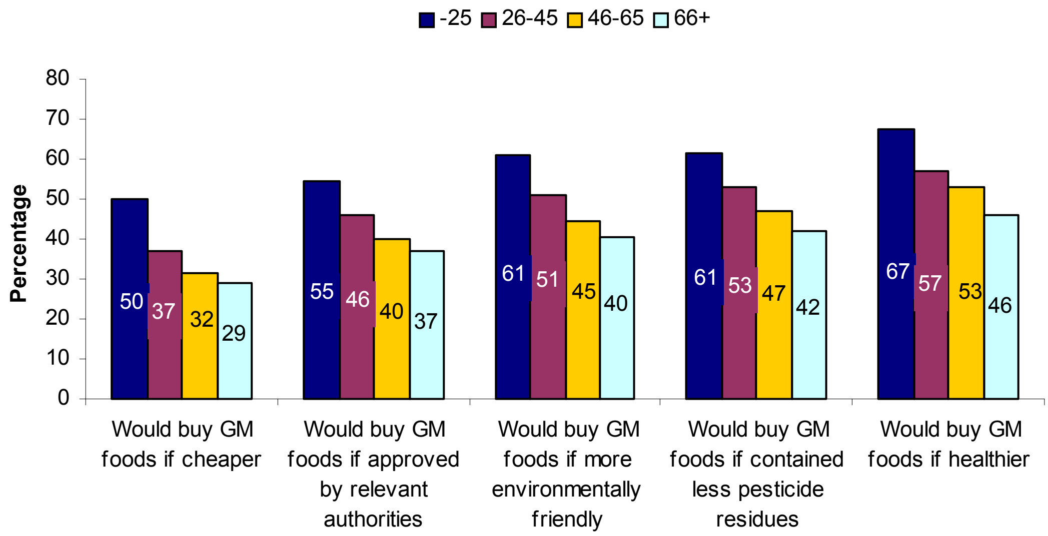
Table 36: Age and support for four biotechnologies



The youngest age group express a clear positive attitude towards a range of technologies. Respondents aged 25 or younger are slightly more likely than those aged 26-45 and 46-65 to be supportive. Again, those aged above 65 are the least likely to be positive, but again a higher proportion of those in this age group give a ‘don’t know’ response to these questions.

This positive belief in new developments may also explain the relatively positive attitude of young people towards GM food, as expressed through the questions on purchasing decisions (see Chapter 4). Figure 37 shows that the younger people are, the more likely they are to state positive intentions towards buying GM food, under all of the conditions stated in the questions.

Figure 37: Age and intentions to purchase GM food



7.2 Interest in politics and science and technology

Turning now to issues of engagement (see Chapter 7), Figures 38 and 39 show responses by age to the questions ‘how interested are you in science and technology?’ and ‘in politics?’. Respondents were also asked whether they keep up to date on these issues and how often they discuss such topics with other people.

Figure 38: Age and interest in science and technology

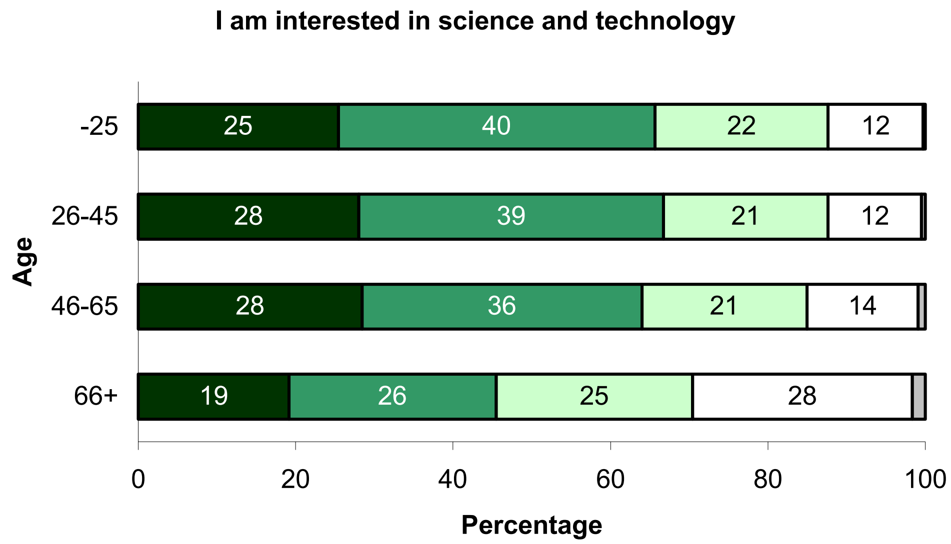
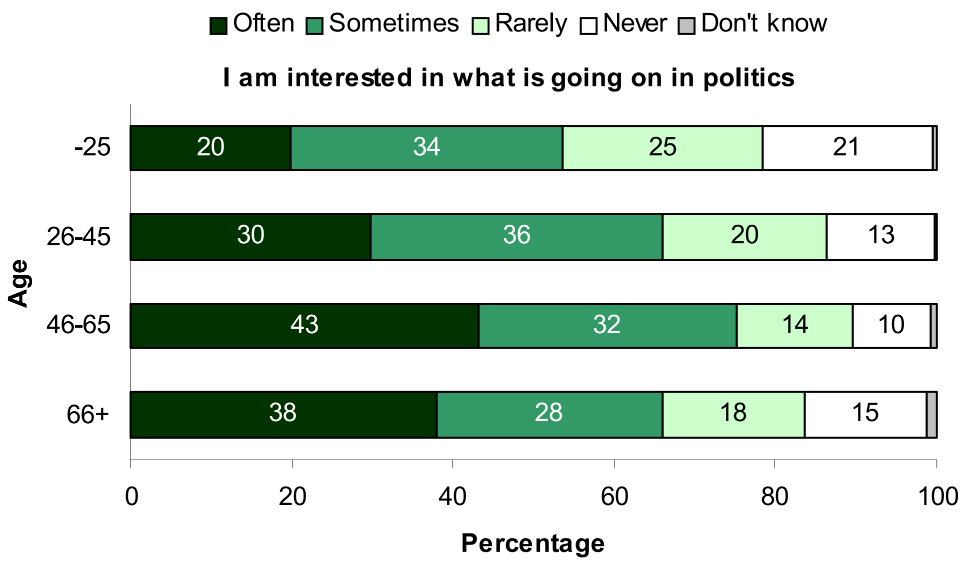


Figure 39: Age and interest in politics



Figures 38 and 39 show that the older age group express relatively low interest in science and technology. The youngest group of respondents express a similar level of interest to the middle two groups. When it comes to interest in politics, however, a different picture emerges. Younger people are less interested than the others, a trend that is consistent with the widely recognised decline in recruitment into political youth organisations in European countries and low youth participation in general elections.

7.3 Knowledge

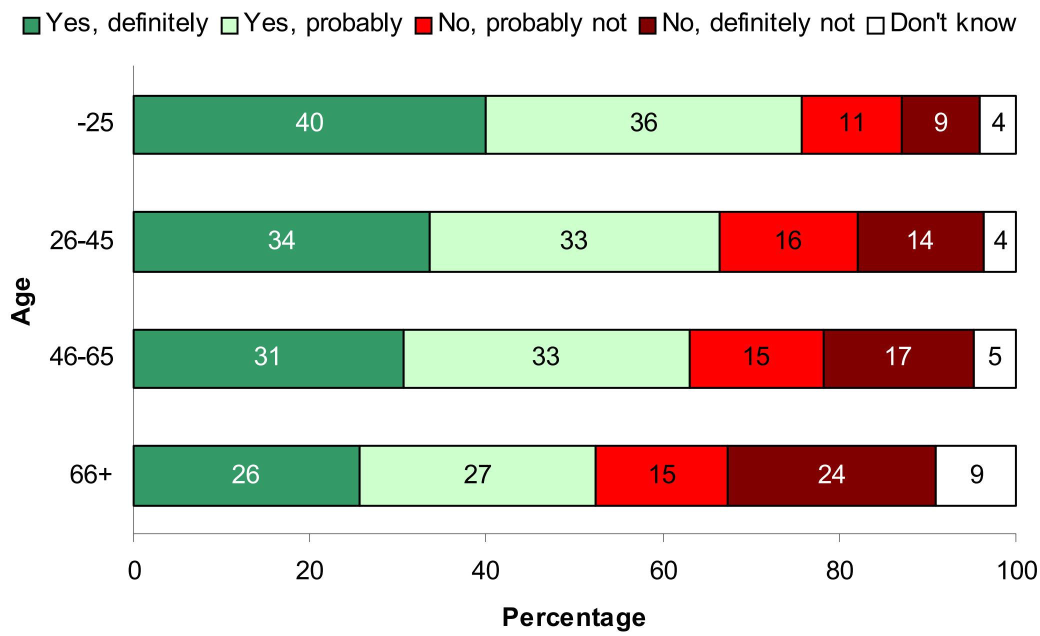
As described in Chapter 7, respondents were asked ten questions to test their textbook science knowledge about genes and biotechnology issues. There are no differences between the average number of correct answers among the two younger old groups, where respondents score an average 5.6 correct answers. Those in the 46-65 group score 5.2 on average. In the 66+ group, by contrast, the average number of correct answers is just 3.9.

Younger people thus have similar levels of textbook science knowledge, on average, to all age groups apart from the oldest. But recall from Chapter 7 that three items in the knowledge quiz are designed to tap into menacing images of biotechnology ('ordinary tomatoes do not contain genes', 'GM animals are always bigger than ordinary ones', and 'eating GM fruit might alter a person's genes'). On these particular items, the young are the most likely to answer these questions correctly. As age increases so there is a decreasing likelihood of a correct answer. It is those in the middle age group, 46-65, who are most likely to think that these statements are true. The 66+ age group, again, are most likely to say that they don't know the answer to the question.

7.4 Own body and health

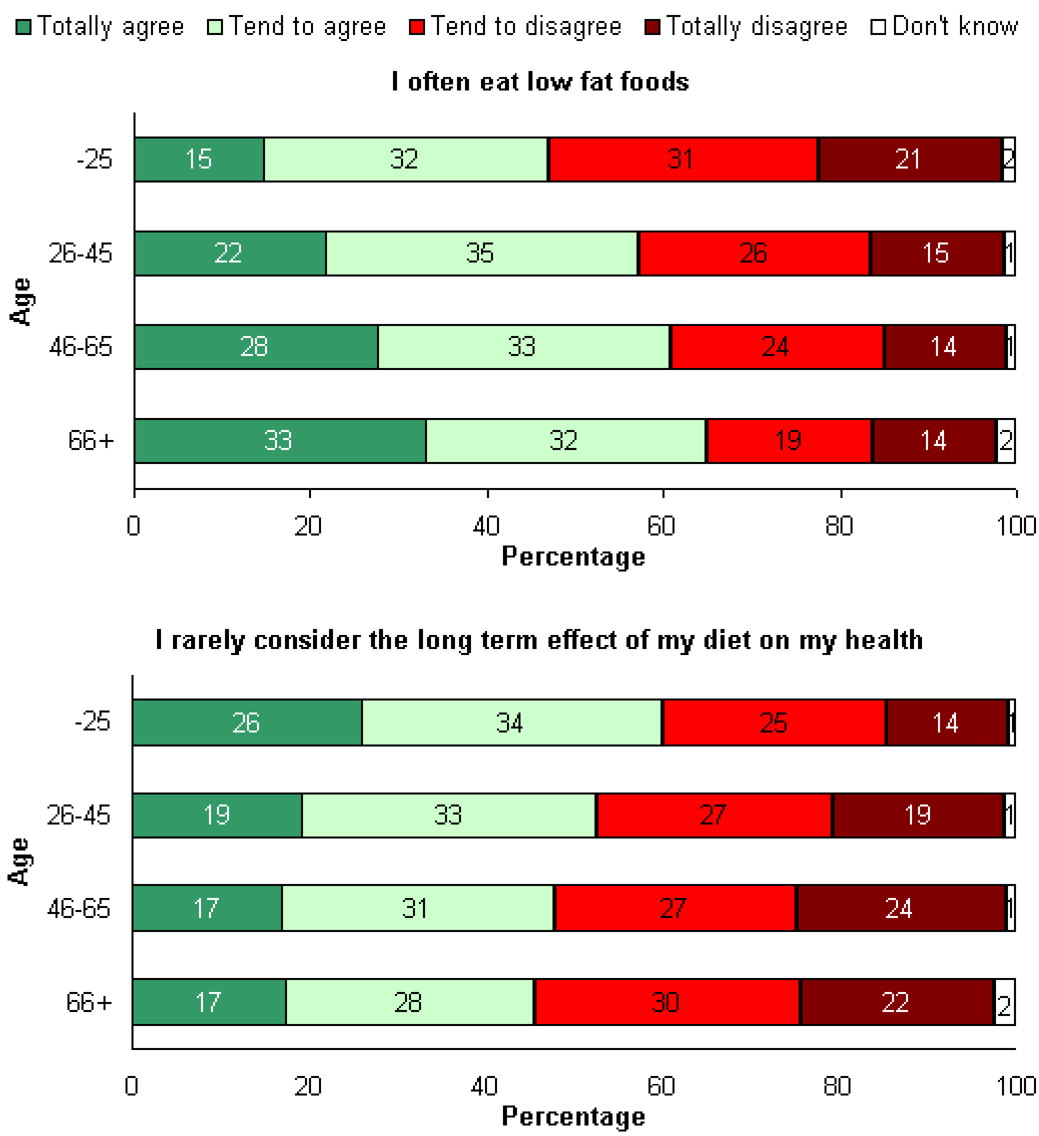
Research on youth reveals that compared to previous generations, young people today are significantly more worried about their appearance and their health. This concern may partly explain the youngest respondents' willingness to take a genetic test in order to detect any serious disease that they might get (Figure 40). Compared to the older age groups, young people appear to be more willing to take such a test.

Figure 40: Age and willingness to take a genetic test to detect serious disease



It might be expected that the concern with health in the media and among youth would result in a particularly healthy youth generation. This does not seem to be the case, however (Figure 41). Respondents were asked about their views on some issues around food and eating. The youngest age group appears to hold a rather unconcerned view; compared to the other age groups, younger people say they think less often about the long term effect of their diet on their health, eat low fat foods less often, and they see themselves as healthy eaters to a lesser extent.

Figure 41: Age, food and health



Overview

Is the younger generation of Europeans turning against science and technology? The snapshot from the Eurobarometer would suggest not. The age group from 15-25 is no less optimistic about technological innovation, no less willing to support nanotechnology, gene therapy, pharmacogenetics and

GM food, and just as interested in science and technology as are older people. On all these opinions about science and technology it is the over 65s that are either more critical or not prepared to express an opinion.

Younger people are more likely to say they would buy GM food and less likely to hold menacing images of GM food than older people. However, on two issues the 15-25s are less concerned. They are less engaged in politics and less likely to worry about the links between diet and health. In the context of the emerging problem of obesity, the findings are hardly encouraging.

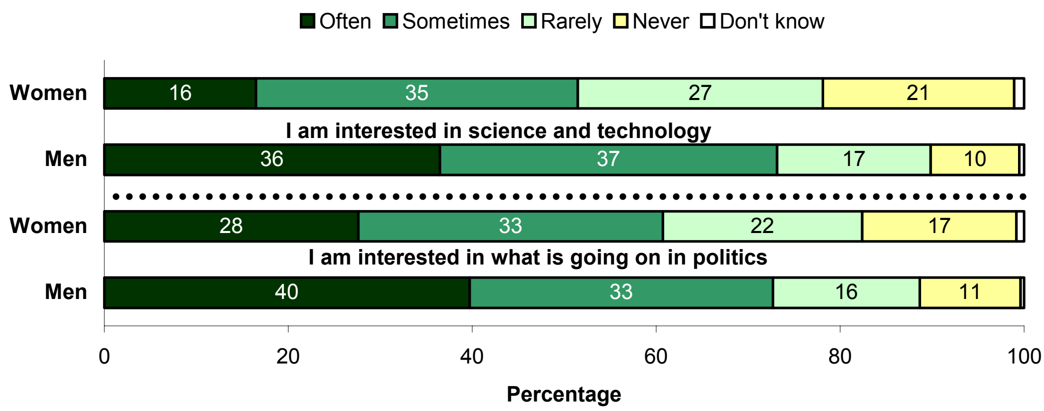
8. Women and science

Although more women in Europe are in employment, more are entering higher education and more are going into science than in the past, it is still the case that women are under-represented in careers in many areas of science. While such human resource issues are beyond the scope of the Eurobarometer on biotechnology, in the following paragraphs we take a brief look at gender differences as evidenced in this survey.

8.1 Interest and knowledge in science and technology

Figure 42 shows that there are clear differences between men and women in their levels of interest in matters of science and technology. Compared to women, a greater percentage of men say they are 'sometimes' or 'often' interested in science and technology. This is also true with respect to interest in politics. However, the difference between men and women is greater for science than for politics.

Figure 42: Gender and interest in science and technology, and politics

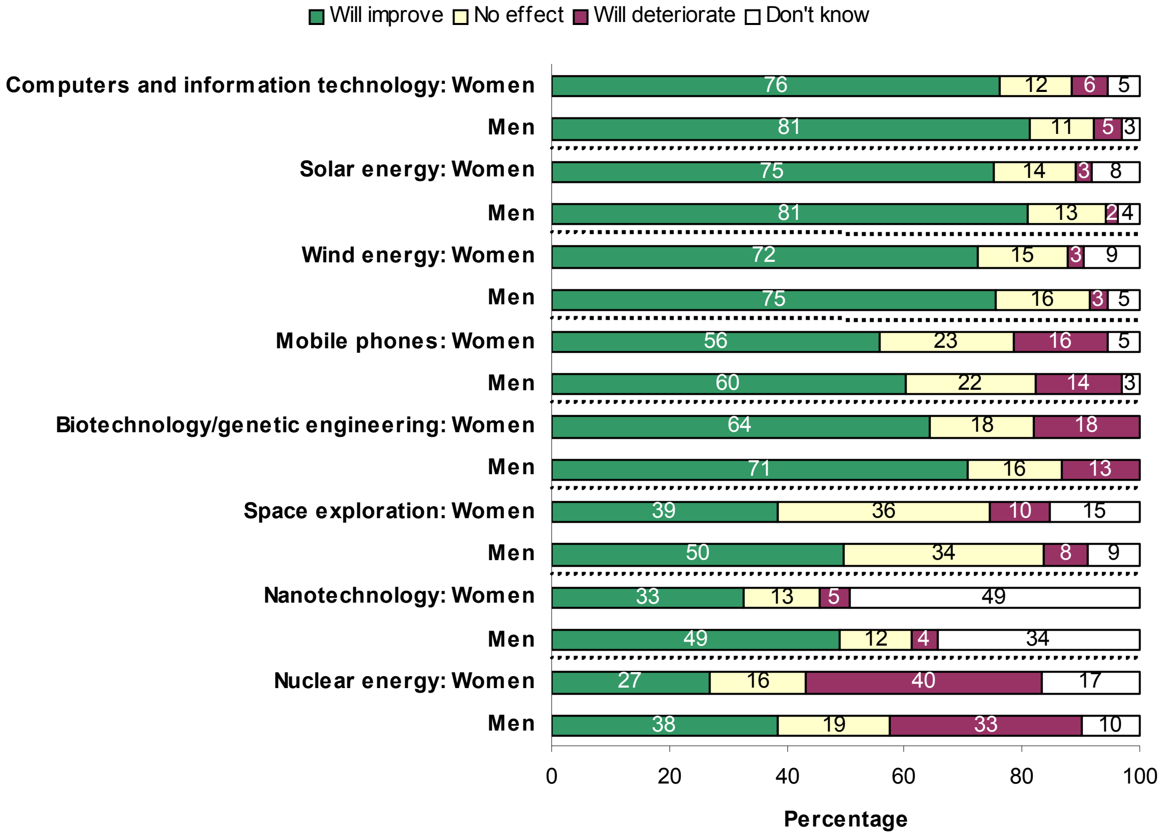


In relation to knowledge about biology and genetics, there is a small average difference between men and women. For men, the average number of correct answers to the ten-item quiz is 5.4. For women, the score is 5.0. On eight of the ten questions more men tend to give correct answers than women. However, women are more likely than men to correctly say that the following statement is true: 'It is possible to find out in the first few months of pregnancy whether a child will have Down's Syndrome'. There are no differences in the percentage of correct answers to the statement 'Embryonic stem cells have the potential to develop into normal humans'.

8.2 Expectations

Figure 43 shows the average levels of optimism and pessimism about various technologies for men and women. The percentage of 'will improve' answers is higher for men across all technologies and the percentage of 'will deteriorate' answers is greater for women, except in the case of 'wind energy.' The proportion of 'don't know' answers is always higher for women than it is for men, reaching almost half of those women surveyed (49 per cent) in the case of nanotechnology.

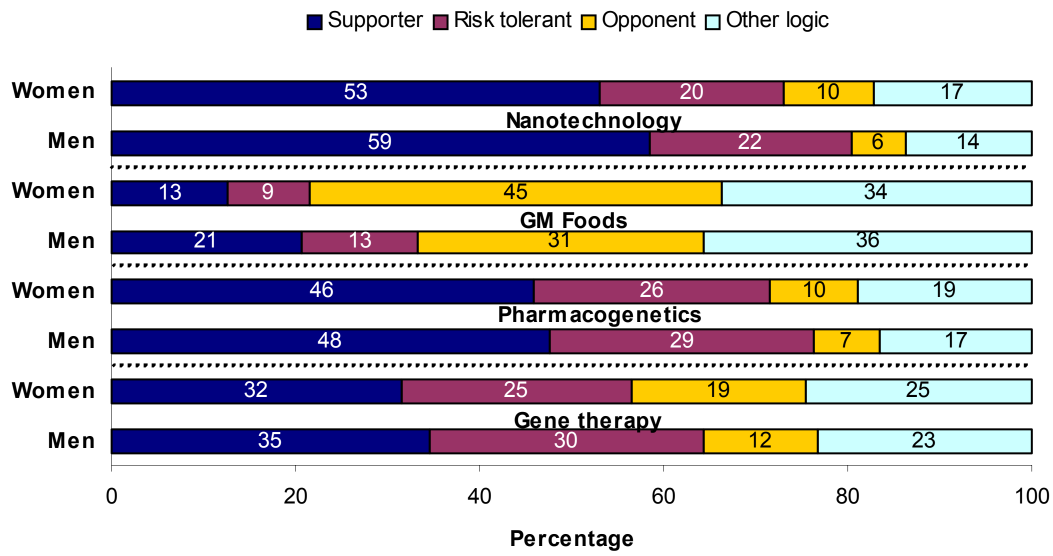
Figure 43: Gender and optimism about technology



8.3 Gender and the 'logics' of support and opposition

Figure 44 shows differences in the percentage of women and men who (see Chapter 4) we characterize as 'outright supporters', 'risk tolerant supporters', 'opponents' and having 'other logics' in relation to gene therapy, pharmacognetics, GM food and nanotechnology. While we can observe some clear differences for men and women, if we split the sample according to levels of education, we see some interesting findings.

Figure 44: Gender and logics of support for four technologies



In the case of gene therapy, there is a notable increase among women in the percentage of 'supporters' as the age they left formal education increases (25 per cent in those who left before the age of 15; 31 per cent for those between 16 and 19 years of age and 36 per cent in those who left formal education after the age of 20), whereas these percentages vary little in the case of men (34 per cent, 34 per cent and 33 per cent respectively). Moreover, as levels of education increase so the differences between men and women decrease.

There is a similar pattern in the cases of both pharmacogenetics and nanotechnology. But the situation is reversed with regard to GM food. Here the percentage of men who are 'supporters' increases with more years of education, while this effect is not seen in women.

8.4 Modes of Engagement

As well as attitudinal differences, there are quite distinct differences between men and women in their modes of engagement with biotechnology. Table 12 shows the percentage of men and women who make up each of the four groups of citizens described earlier in Chapter 4. It also contrasts men and women with and without university degrees.

Table 12: Age, education and modes of engagement

%	Unengaged	Spectator	Attentive	Active
No Degree				
Male	41	50	59	49
Female	59	50	41	51
Degree				
Male	46	48	62	62
Female	54	52	38	38

Table 12 shows that there are more females than males in the 'unengaged' group, a trend that is particularly strong for those who do not have a university degree. There are roughly the same number of males and females in the 'spectator' group. Males are more likely than females to be found in the 'attentive' group, especially those with degrees. Finally, among those without a degree, there is no gender difference in the 'active' group. But among those with a degree, there is a gender difference: compared to women, more men have heard and talked about biotechnology, and might be found attending public meetings on this topic (see Chapter 6).

Typically, surveys on science and technology show that women are less interested in, and less supportive of, science and technology. The findings from the Eurobarometer suggest that we must be cautious about such generalisations on gender differences. On five of the eight technologies, women are almost as optimistic as men that they will improve our way of life; while men are generally more knowledgeable about biology and genetics, women out-score men on questions around pregnancy – an issue of direct concern to them; on approval for nanotechnology, gene therapy and pharmacogenetics differences between women and men are not pronounced and amongst more educated women the gender difference is much smaller. However, women with higher education are less likely to show an attentive or an active interest in biotechnology. Is this more likely to be a consequence of the traditional division of labour in European households, rather than an intrinsic lack of interest among women?

9. Science Culture in the New Member States

In 2005, ten new Member States joined the European Union. In addition to the Mediterranean islands of Malta and Cyprus, the other eight – Estonia, Latvia, Lithuania, Hungary, Czech Republic, Poland, Slovenia and Slovakia – had experienced around 50 years of socialism. Through the lens of the Eurobarometer we investigate the 'science cultures' that these new Member States have brought to the EU.

Generally speaking, these are countries that are in the industrial phase of development (in comparison to some of the EU15 countries that are moving towards the post-industrial phase). Typically, in the industrial phase of development, while science has made only limited penetration into the public sphere, it is idealised as the preferred route to social and economic progress[19]. However, this industrialisation hypothesis may not hold for the eight ex-communist countries. Could fifty years of communism have suppressed cultural differences, and/or led to a quite different science culture?

9.1 Indicators of science culture

Thus far, we have reported the results for particular questions included in the survey. For a preliminary exploration of science cultures – and it is very preliminary as the survey was not designed for this purpose – we create a number of indicators that tap into dimensions of science culture.

Table 13: Indicators of science culture: the new Accession States and EU15

	Index of awareness	% engaged	Index of knowledge	Index of menacing images	Index of optimism	Index of support for medical biotech	Index of support for industrial biotech	Index of support for GM food	Index of trust	% for scientific delegation
Czech Republic	0.91*	18	5.4	1.0	5.2	5.8	10.3	2.5	3.8	67
Estonia	0.95	15	4.4	1.1	5.2	6.1	9.7	1.9	2.8	60
Cyprus	0.94	11	4.3	1.3	5.1	6.7	9.6	1.7	4.3	64
Hungary	0.95	22	4.6	1.0	5.1	5.6	9.0	2.0	3.5	72
Slovakia	0.95	19	4.9	1.1	4.8	5.6	9.4	2.2	3.6	59
Poland	0.80	19	4.6	1.2	4.8	5.9	9.0	2.1	3.2	59
Slovenia	0.88	20	5.1	1.1	4.7	4.8	9.4	2.0	3.4	46
Lithuania	0.69	15	3.4	1.1	4.6	5.5	9.4	2.2	3.2	71
Malta	0.63	9	3.8	0.8	4.5	5.4	10.0	2.4	3.6	58
Latvia	0.87	12	3.7	1.3	4.3	5.9	9.3	1.8	3.8	64
EU15	**1.00**	**28**	**5.3**	**0.8**	**4.5**	**5.7**	**9.5**	**2.0**	**2.9**	**59**
EU15 lowest	0.78	10	3.6	0.5	3.7	5.1	8.2	1.6	2.0	36
EU15 highest	1.25	45	6.8	1.5	5.3	6.3	10.3	2.5	4.1	67

* The numbers in red are those that are below the EU15 mean.

The first index in the table, 'awareness', shows the average number of technologies with which respondents report being familiar: gene therapy and pharmacogenetics for those in split ballot A, or GM food and nanotechnology for those in split ballot B. The range of this variable is therefore 0-2, with the average across the old EU15 countries being 1.

The next indicator is the percentage of respondents in each country who are classified as engaged (that is, ‘active’ or ‘attentive’) in the typology described in Chapter 6. Following this, the index of knowledge gives the average number of items answered correctly from the ‘knowledge quiz’ (again described in Chapter 6), with possible range 0-10. Next presented is the average number of incorrect responses given to the three knowledge items that capture menacing images of biotechnology (ordinary tomatoes do not contain genes while GM tomatoes do; by eating a GM fruit one’s own genes could become modified; GM animals are always bigger than non-GM animals); here the possible range is thus 0-3.

The next indicator is technological optimism, giving the average number of the technologies which respondents think will improve our way of life over the next twenty years (as listed in Chapter 2, Figure 1). Possible scores on this index range from 0 to 8.

The next three indicators are summary measures of support for different types of biotechnologies: red, white and green. Medical (red) biotechnology comprises two items gauging levels of encouragement for gene therapy and pharmacogenetics (from 2, low encouragement, to 8, high encouragement). industrial (white) biotechnology comprises three items: two asking respondents whether the biofuels and bioplastics industries should get tax incentives to allow them to compete with the oil or petrochemicals industry; and one on support for biopharming (low support 3, high support 12). Finally, agricultural (green) biotechnology is the mean level of support for GM food (low support 1, high support 4).

Following these indices, the index of trust shows the average number of actors in the biotechnology system whom respondents say are ‘doing a good job for society’; possible scores range from 0 to 5, with the five relevant actors being industry, industrial scientists, academic scientists, one’s own government, and the EU. In the final column of the table we give for each country (and for the old EU15 as a whole) the percentage of respondents who favour ‘scientific delegation’ (see Chapter 5) for the governance of science.

Table 13 contrasts the new Accession States (denoted as New EU10) with the EU15 countries. For each indicator the mean score is presented for the New EU10 countries (for the variables ‘engaged’ and ‘for scientific delegation’, these are simple percentages, as indicated in the table). For EU15, we include the mean score and the lowest and highest country score on the particular indicator.

Taking the New EU10 as a group, there is considerable variability across the indicators. That the range, from lowest to highest, is smaller than for EU15 is to be expected, as EU15 combines countries in the industrial and post-industrial phases of development. The Czech Republic is closest to the EU15 profile and the contrast with Slovakia is rather striking. It seems reasonable to conclude that the history of the last fifty years has not led to a homogeneity of public opinion about science and technology.

The results appear to provide qualified support for the industrialisation hypothesis. Science and technology has low penetration into the public domain in the New EU10. Here we find generally lower awareness, fewer active and engaged people, lower scientific knowledge, and more menacing images than in EU15. But significantly, all but two (Malta and Latvia) of the New EU10 are above the EU15 mean for technological optimism. These two findings support the industrialisation hypothesis and suggest that science, while not very familiar, is idealised as the route to economic progress.

However, on support for medical and industrial biotechnologies and GM food, the New EU10 countries are rather similar to the EU15. Seven of the New EU10 countries are above or very close (within 0.1 scale points) to the mean score for EU15 for medical and industrial biotechnologies and GM food.

On the two indicators of trust – in the biotechnology system, and in scientific delegation as the preferred principle of governance – the New EU10 are shown to be, with one exception, at or above the EU15 mean score.

Have the ten new Member States changed the scientific culture of the European Union? The answer is ‘probably not’. Collectively the ten new countries are just about as heterogeneous as are the old EU15 countries, judged by this set of indicators of science culture. As many of the ten are in the industrial stage of development, they share some common features that were also seen in other ‘new entrants’ to the EU in the past. As such, the New EU10 are somewhat different to the EU15 countries in 2005. First, by comparison to EU15, science has not achieved much penetration in public awareness in the new Accession States. Second, the publics in these countries are relatively more optimistic about the contribution of technology to society, and are just as supportive of medical, industrial and agricultural biotechnologies. They also have greater trust in actors and institutions involved in science and technology. But, as has been seen in other EU Member States, such views can be subject to dramatic changes.

10. A transatlantic perspective

This final chapter puts some of the findings presented earlier in the report in a transatlantic context. A number of the questions in the Eurobarometer survey were included in the International Biotechnology Survey Group's 2005 studies in US and Canada[20]. The Canadian survey had a sample of 2,000 and the US survey had a sample of 1,200. From the three surveys we make some analyses, focusing in particular on technology optimism and attitudes to GM food and nanotechnology.

10.1 Optimism about technologies

Table 14 shows that, apart from nuclear energy, Europeans are more or less as optimistic about computers and IT, biotechnology and nanotechnology as citizens of US and Canada (on average). 'Old Europe' does not appear to be peopled by Luddites. However, nuclear energy is an interesting case. On the one hand, it attracts the least optimism of any of the four considered. And on the other hand, Europeans are somewhat less optimistic, on average, than Canadians, and considerably less optimistic than citizens of US.

Table 14: Optimism in new technologies

Do you think each of the following technologies will improve our way of life in the next 20 years?	**% Europe**	**% US**	**% Canada**
Computers and IT	82	86	83
Biotechnology	75	78	75
Nanotechnology	70	71	68
Nuclear Energy	37	59	46

An explanation of the apparent differences between figures for Europe in Table 14 and Figure 1 (page 10) is in order. In the North American surveys respondents were asked about only biotechnology. Thus the European figure of 70 per cent optimistic in Table 14 is taken from the split ballot concerning biotechnology. (Europeans are more optimistic about biotechnology than they are about genetic engineering). Furthermore, the percentages in Table 14 are based on excluding respondents who said 'don't know'. Taking the example of nanotechnology, Figure 1 shows 40 per cent optimistic and 42 per cent 'don't know', while Table 14 reports 70 per cent optimistic. This is based on the following: 40.5 (optimistic) divided by 57.9 (all those who gave an opinion) equals 0.70; 0.70 times 100 equals 70 percent. In a similar way, the exclusion of 'don't know' respondents for *biotechnology* explains the apparent difference between Figure 1 and Table 14.

10.2 Evaluating GM food and nanotechnology

Turning to more specific attitudes, we consider the cases of GM food and nanotechnology. For each of these technologies, respondents were asked whether they are useful for society, risky for society and morally acceptable; whether they were confident in the current regulatory arrangements; and whether they approved of its use or not. To make the survey data comparable, where necessary we recoded the five-point US and Canadian response scales and the four-point European response scales into an eleven-point scale (0-10).

On GM food, Europeans and Canadians have rather similar views, on average (Table 15). The only difference of note is that the Canadians see GM food as slightly more morally acceptable than do Europeans. People in US see GM food as being more useful for society, less risky, more morally acceptable, and have somewhat more confidence in its regulation.

Table 15: Perceptions of GM food and nanotechnology

GM food	Europe	US	Canada
Useful for society	4.55	5.15	4.42
Risky	6.11	5.30	6.08
Morally acceptable	4.59	6.22	5.44
Confidence in current regulatory arrangements	3.85	4.25	3.85
Nanotechnology			
Useful for society	7.19	6.80	6.73
Risky	4.23	4.28	4.66
Morally acceptable	7.07	7.08	6.59
Confidence in current regulatory arrangements	5.29	4.83	4.69

With nanotechnology, Europe's position is strikingly different. In comparison to people in US and Canada, Europeans see nanotechnology as more useful and have greater confidence in its regulation. Canadians tend to perceive greater risks in nanotechnology and lower moral acceptability.

These perceptions of GM food and nanotechnology translate broadly into approval for the technologies, either with current or tighter regulations. There is greater support for GM food in US than Canada, and in Canada than Europe (Table 16). Support for nanotechnology is fairly similar across the three cases.

Table 16: Approval of GM food and nanotechnology

Unqualified and qualified approval	% Europe	% US	% Canada
GM food	45	61	53
Nanotechnology	76	81	81

Finally, looking across Europe, Canada and US, we examine whether use, risk, moral and confidence in regulation (attributes) play the same role in informing people's approval of the two technologies. For this we use binary logistic regression, predicting unqualified and qualified approval from the four attributes. Table 17 shows the regression coefficients, all of which are statistically significant. In all cases, use, risk, moral acceptability and confidence in regulation play separate roles in the prediction of approval.

However, there are some interesting differences across Europe, Canada and US.

Table 17: Regressing approval of GM food and nanotechnology on their attributes

	B Europe	*B* USA	*B* Canada
GM food			
Useful	**.31***	**.42***	.30*
Risky	-.16*	-.24*	**-.41***
Morally acceptable	.19*	.18*	.25*
Confidence in regulation	**.31***	.28*	.21*
Nanotechnology			
Useful	**.38***	**.38***	.23*
Risky	-.19*	-.23*	-.24*
Morally acceptable	.21*	.24*	.23*
Confidence in regulation	**.45***	.14*	**.30***

* p<.001

In Europe, it appears that perception of use and confidence in regulation play the most important roles; in US it is usefulness; and in Canada the most prominent attributes are risk for GM food and confidence in regulation for nanotechnology. The pattern in Europe, emphasising the questions of benefits relating to new technologies and confidence (trust) in regulation, has been described elsewhere[21]

On the basis of these analyses it does not seem reasonable to claim that European public opinion is a constraint to technological innovation and has contributed to the technological gap between the US and Europe. With the exception of nuclear energy, Europeans are more or less as optimistic about computers and IT, biotechnology and nanotechnology as are people of US and Canada. The major exception is GM food for which Europeans and Canadians have rather similar views, while for people in US it is seen as much more beneficial and less risky.

Europe’s position is strikingly different on nanotechnology. In comparison to people in US and Canada, Europeans see nanotechnology as more useful and have greater confidence in its regulation.

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