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Climate Change for Biotechnology? UK Public Opinion 1991–2002

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The 1991–2002 Eurobarometer surveys show a steady decline in optimism about biotechnology in the United Kingdom (UK) through the 1990s. After 1999, there is more optimism and less opposition to agri-food biotechnologies. The paper discusses possible causes of these changes and argues that the UK public is still open to persuasion.

Key words: biotechnology, Eurobarometer survey, GM foods, GM crops, public opinion, United Kingdom.

Introduction

The United Kingdom's government-sponsored debate on genetically modified crops, "GM Nation?," was launched on June 3, 2003, with the intention of promoting a wide-ranging and effective public debate that went beyond the often polarized views in order to find out what people really think about genetic modification.

What people really think about modern biotechnology has been a concern for some time (Durant, 1992). As long ago as 1994, a consensus conference discussed agricultural biotechnologies (Joss & Durant, 1995). There have been a number of qualitative studies on the topic, mainly using focus groups (Grove-White, Macnaghten, Mayer, & Wynne, 1997; Marris, Wynne, Simmons, & Weldon, 2001; Shaw, 2002). All these approaches to assessing public opinion have strengths and weaknesses. They give voice to those who participate and can provide insights into important currents of opinion among the public. However, there is always a question of who it is that participates in these events and the extent to which the results reflect the wider public.

The social survey is another approach to public opinion. In this summary of UK public opinion, we draw upon the results of one particular survey: the Eurobarometer on biotechnology organized by the European Commission (Gaskell, Allum, & Stares, 2003). We do so for two reasons. First, we were involved in the design of the survey questionnaires. Second, the series of Eurobarometer surveys (henceforth referred to as EB surveys) in 1991, 1993, 1996, 1999, and 2002 provide some time series data, enabling us to look at the evolution of public perceptions over the period in which modern biotechnology has moved from the laboratory to applications in everyday life.

Survey Research and Public Consultation

It is not unreasonable to claim that survey research is a form of public consultation in that within the constraints of the method, it gives voice to a representative sample of the public, from which one can say something about the population within established confidence limits. A survey is not a form of direct participation or dialogue with the public. Yet, if the views expressed in a survey inform official discussions and decisions, then scientific surveys are a valuable tool in modern democracies.

Two features of survey research deserve comment. First, a survey frames issues in a particular way; respondents are restricted to answering the questions within the response alternatives presented. From prior qualitative research and the existing literature, the team that devised the questionnaires tried to capture the significant currents of opinion about biotechnology and to set the questions in the context of relevant social scientific concepts. Second, survey data does not speak for itself

or provide objective truths. The selection and interpretation of data (such as percentages) involve prior assumptions and value judgments about what is relatively important and relatively less important.

Biotechnology Enters the Public Sphere

As long ago as the late 1980s, when biotechnology was still confined to the laboratory, the importance of public perceptions was recognized. Mark Cantley wrote that "public and political opinion was learning to seeing gene technology, genetic engineering, biotechnology and so on as a single, vague and disquieting phenomenon" (Cantley, 1992). A social survey in 1979 found that 36% of the British public saw genetic research as an unacceptable risk; a similar percentage thought the same about "synthetic" food. A European Federation of Biotechnology task group argued that although education and information were needed to overcome irrational public fears, efforts should above all be made to build trust through scientific, financial, political, and environmental accountability (see Cantley, 1992). However, the promoters of biotechnology were in overdrive with techno-hype, and such warnings had little impact. The new life sciences and their applications in the domains of health and agriculture were progress writ large; how could anyone, other than the messianic antitechnologists, think otherwise?

The 1990s saw some of the first consumer applications of biotechnology. In the latter category was so-called vegetarian cheese. Unlike traditional animal rennet, the enzyme chymosin was a biotechnological product. Perhaps more notable was the development of genetically modified (GM) tomatoes. To considerable publicity, Calgene launched the Flavr Savr™ tomato in the United States. In the United Kingdom, Zeneca's GM tomato puree arrived on the shelves of Sainsbury's and Safeway supermarkets in 1996. It was described by the former as "Californian tomato puree: made with genetically modified tomatoes;" on the back of the can further information included, "the benefits of using genetically modified tomatoes for this product are less waste and reduced energy in processing." For the same price as conventional puree, the GM puree offered 20% more weight.

This product apparently sold well, but for technical reasons the product was subsequently withdrawn. Notwithstanding the commercial failure of the product and headlines about "Frankenfoods," there was little public debate or consumer opposition, which may have led both industry and government to assume that GM products as a whole would meet with consumer acceptance. However, as we will show later in this report, the concerns expressed by the British public in the late 1970s have not disappeared.

Next came the watershed years of 1996–1999, in which three events stand out (Gaskell & Bauer, 2001). In different ways, they set the agenda for policymaking, dominated media coverage, and raised the public profile of biotechnology. In 1997, the cloning of Dolly the Sheep turned science fiction into reality and led to fears about what would happen in the future. Although not directly related to biotechnology, the BSE ("mad cow disease") crisis in 1996 demonstrated the limitations of scientific expertise and introduced the public to industrialized agriculture. Finally, there was the long-running GM food debate. Starting in 1996 with the importing of the first GM soya into the United Kingdom, the debate reached a crescendo with the controversy over the work of Pusztai in 1998 and 1999, and biotechnology became an issue for Royalty and party politics. Depending on one's perspective, this debate showed the hubris of science or illustrated the irresponsibility of nongovernmental organizations (NGOs) and elements of the media.

The regulatory arrangements were substantially overhauled in 1999 (Gaskell, Bauer, Allum, Lindsey, & Durant, 2001). The Human Genetic Commission, the Agriculture and Environment Biotechnology Commission, and the Food Standards Agency (in 2000) broke with the past with a commitment to openness, consultation, and transparency, seen in new procedures for committee deliberations and public consultation.

In this report, we look at two representations of biotechnology in the public sphere: media coverage and public perceptions.

Media Coverage of Biotechnology

Figure 1 shows the coverage of biotechnology over the period 1973 to 2002, based on the opinion-leading elite press represented by the *Times* (1973–1987) and the *Independent* (1988–2002). It depicts the number of articles featuring terms such as *DNA*, *biotechnology*, *genetic engineering*, and more recently, for example, *GM foods*, *cloning*, and the *human genome*. The volume of coverage is taken as an index of salience—the social significance of the topic (Bauer, Kohring, Gutteling, & Allansdottir, 2001). The salience of biotechnology increased very slowly from 1973 to 1991, picked up in the years 1992–1995, and then rose dramatically from 1996 to a peak in 1999. The increase in coverage over these "watershed" years is matched by the subsequent

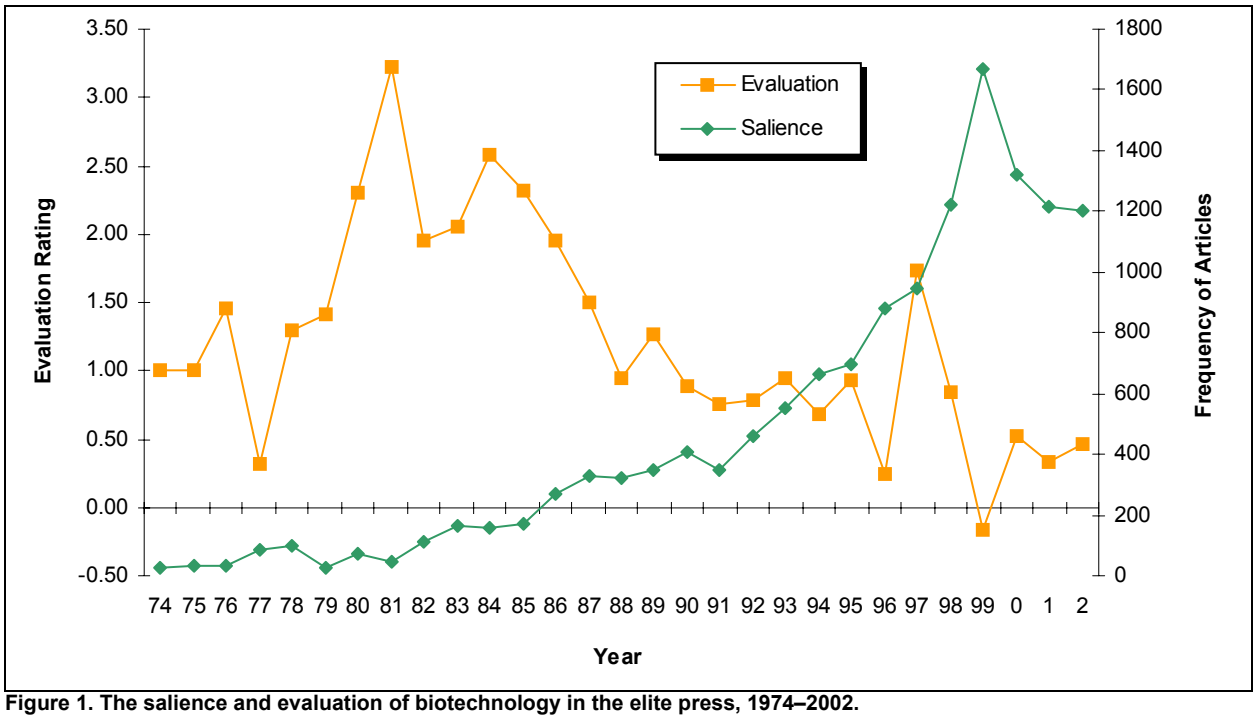

Figure 1. The salience and evaluation of biotechnology in the elite press, 1974–2002.

decline observed thereafter. For details of sampling methodology, the coding frame, and reliability analyses, see Durant, Bauer, and Gaskell (1998, pp. 276-298).

The second line in Figure 1 shows changes in the average rating of evaluative tone of articles in the press over the period. The scale runs from +5 (very positive) to –5 (very negative). This is based on a systematic sample of the articles in any one year and using classical content analysis, where the negative valuation achieved 80% coder agreement and the positive valuation 76% agreement (Durant et al., 1998). Roughly speaking, the evaluative tone becomes more positive over the 1970s to reach a peak in about 1981. Thereafter, with some deviations the evaluative tone declines progressively until the low point in 1999. This corresponds to the peak of media coverage during the GM food debate. From 1999 to 2002, the tone becomes more positive; again, it would seem related to the overall decline in coverage.

Overall, the press coverage of biotechnology tends to be positive, and over the last 25 years, the volume has increased more than a hundredfold. As the volume of coverage has increased, so has there been a decline in the favorability of the average article on biotechnology. In this regard, 1999 is an extreme year. Here coverage was dominated by the GM food controversy, and for the first time the tone of the average article was negative.

Public Perceptions

Biotechnology: Controversial for Some, Unnoticed by Others

From the increasing volume of press coverage, it might be assumed that biotechnology and issues such as GM foods are a hot topic for the general public. After all, here is a technology that is revolutionizing health care, reproductive techniques, agriculture, and food. The EB surveys tell a slightly different story.

In 1996, UK respondents in the EB survey were asked: "Before today, have you ever talked about biotechnology with anyone?" About 52% said "no, never." Notwithstanding the explosion in press coverage in the following three years, by 1999 some 59% said "no, never" to the same question. In 2002, it had increased to 64%. Even taking into account the margin of survey error, it can hardly be claimed that the public have become more interested in biotechnology. Interestingly, this figure is higher than those for all of the other European Union countries except Greece. Amongst the UK public who said they had talked about biotechnology, 19% said "yes, occasionally" and 4% said "yes, frequently."

Maybe people do not talk about such matters, but do hear or read about them. When asked, "Over the last three months have you heard or read about biotechnol-

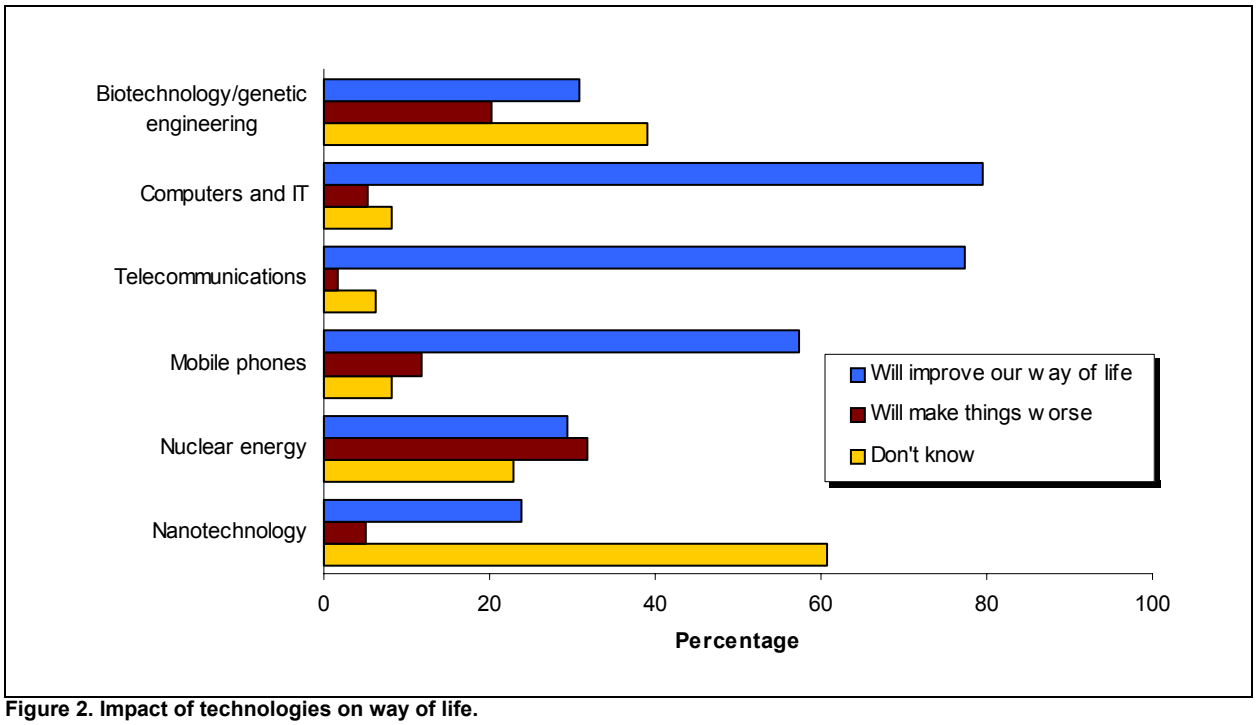

Figure 2. Impact of technologies on way of life.

ogy in newspapers and (separately) on television" the answer was "no" from 73% and 65% of the public respectively. By contrast, before respondents were asked about their opinions of the various applications of biotechnology, around 80% said they heard about cloning and xenotransplantation, and more than 70% had heard of GM foods and genetic testing.

Overall, a mixed picture emerges on the impact of biotechnology in everyday life. Awareness of different applications was relatively high, but a clear majority of respondents did not recall media coverage of the topic or discussing it with other people.

Technological Optimism and Pessimism

Since 1991, the Eurobarometer surveys have charted the public's general attitudes to science and technology. For each of six technologies (solar energy, computers and information technology, telecommunications, space exploration, the internet, and biotechnology) respondents were asked, "Do you think it will improve our way of life in the next 20 years, it will have no effect, or it will make things worse?" In 1999, nuclear energy was added to the list, and in 2002, mobile phones and nanotechnology were included. Figure 2 shows that across the selected technologies Britons are less optimistic about biotechnology and genetic engineering than the other technologies, with the exception of nanotechnology and nuclear power.

The fortunes of the three so-called base technologies of the post WWII years (nuclear energy, computers, and biotechnology) are interesting. The pattern for biotechnology is much closer to nuclear than computers—31% are optimistic about biotechnology, and 20% are pessimistic. The comparable figures for nuclear power are 30% optimistic and 32% pessimistic. Interestingly, this is consistent with the findings of Slovic, Lichtenstein, and Fischoff (1980) that nuclear power and biotechnology (along with pesticides) fall into the category of "dread risks." Contrast this with computers, for which 80% were optimistic and 5% pessimistic. Whereas the large percentage of "don't know" responses for nanotechnology probably reflects basic unfamiliarity, for biotechnology it probably signifies unfamiliarity for some and ambivalence for others.

Changes in technological optimism and pessimism over time (1991–2002) are based on a summary index. This expresses the balance of optimists and pessimists with the "don't know" responses excluded. 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.

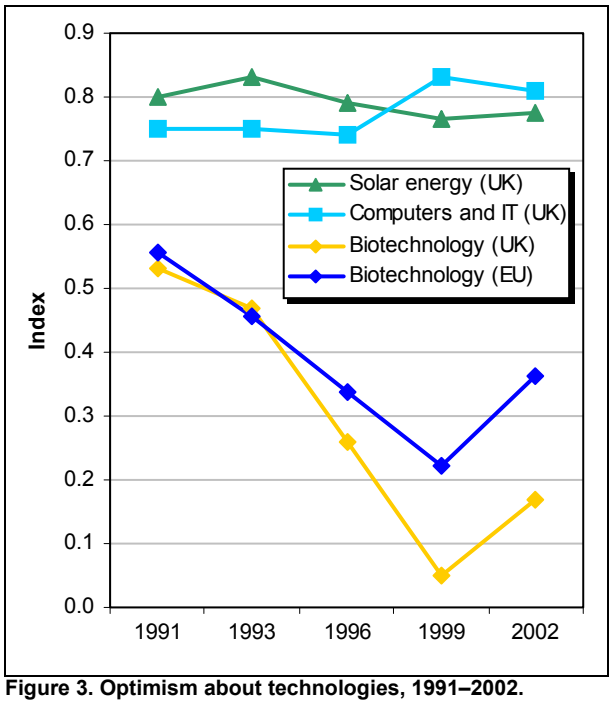

Figure 3. Optimism about technologies, 1991–2002.

Figure 3 shows a notable difference in the fortunes of biotechnology and the other technologies. Levels of optimism about telecommunications, computers, and information technology have been both high and stable over the decade. By contrast, optimism in biotechnology declined steadily over the period 1991–1999 and then rose appreciably between 1999 and 2002. Interestingly, the United Kingdom follows the same pattern as the rest of Europe (EU in Figure 3), but is generally more pessimistic.

Technological Optimism: Implications

What conclusions can be drawn from the data? First, it is clear that the public is not suffering from generalized technophobia. There is overwhelming optimism about the contribution to society of telecommunications, computers and information technology, and solar energy. Second, people's assessments of technology do not appear to be driven by a generalized risk aversion. The possible health and environmental risks of mobile phones have been widely discussed, yet for every pessimist about mobile phones there are about six optimists. Third, and perhaps contrary to expectation given the results for 1991–1999, in more recent years there has been a shift towards greater optimism about biotechnology.

Attitudes to Applications of Biotechnology

Here we move from the general to the specific: the public perceptions of six applications of biotechnology covering the medical, industrial, and agri-food domains. The sample was divided into two equivalent groups in a split ballot design. Each group was asked about three applications, described to the respondents as follows:

Split ballot A:

- Genetic testing: using genetic tests to detect inheritable diseases (such as cystic fibrosis and thalassemia)
- Xenotransplantation: introducing human genes into animals to produce organs for human transplants (such as pigs for human heart transplants).
- GM food: using modern biotechnology in the production of foods (for example, to make them higher in protein, keep longer, or change the taste).

Split ballot B:

- GM crops: taking genes from plant species and transferring them into crop plants to increase resistance to insect pests.
- GM enzymes: using genetically modified organisms to produce enzymes as additives to soaps and detergents that are less damaging to the environment.
- Cloning human cells: cloning human cells or tissues to replace a patient's diseased cells that are not functioning properly (for example, in Parkinson's disease or forms of diabetes or heart disease). Note that in the 1999 survey, this question did not include the three examples of the uses of cloning human cells.

Respondents were asked whether the applications of biotechnology were *useful for society, risky for society, morally acceptable*, or should be *encouraged*. The response alternatives for these questions were 4-point type scales (definitely agree, tend to agree, tend to disagree, and definitely disagree).

Figure 4 shows the mean scores on a scale ranging from +1.5 to –1.5 for the assessments of *use*, *risk*, *moral acceptability*, and to be *encouraged* for each application. (The raw data have been recoded from 1 to 4 into –1.5 to +1.5 in order to show the midpoint of the scale as zero on the figure). Note that all "don't know" responses are excluded and that the six applications are ordered from right to left by the level of encouragement.

The figure shows, as indeed was the case in 1999, that it makes little sense to talk of public perceptions of biotechnology as if people were evaluating a single entity. People continue to distinguish rather sharply between different applications. Genetic testing is perceived to be useful, not risky (just below the zero midpoint), morally acceptable, and to be encouraged. In

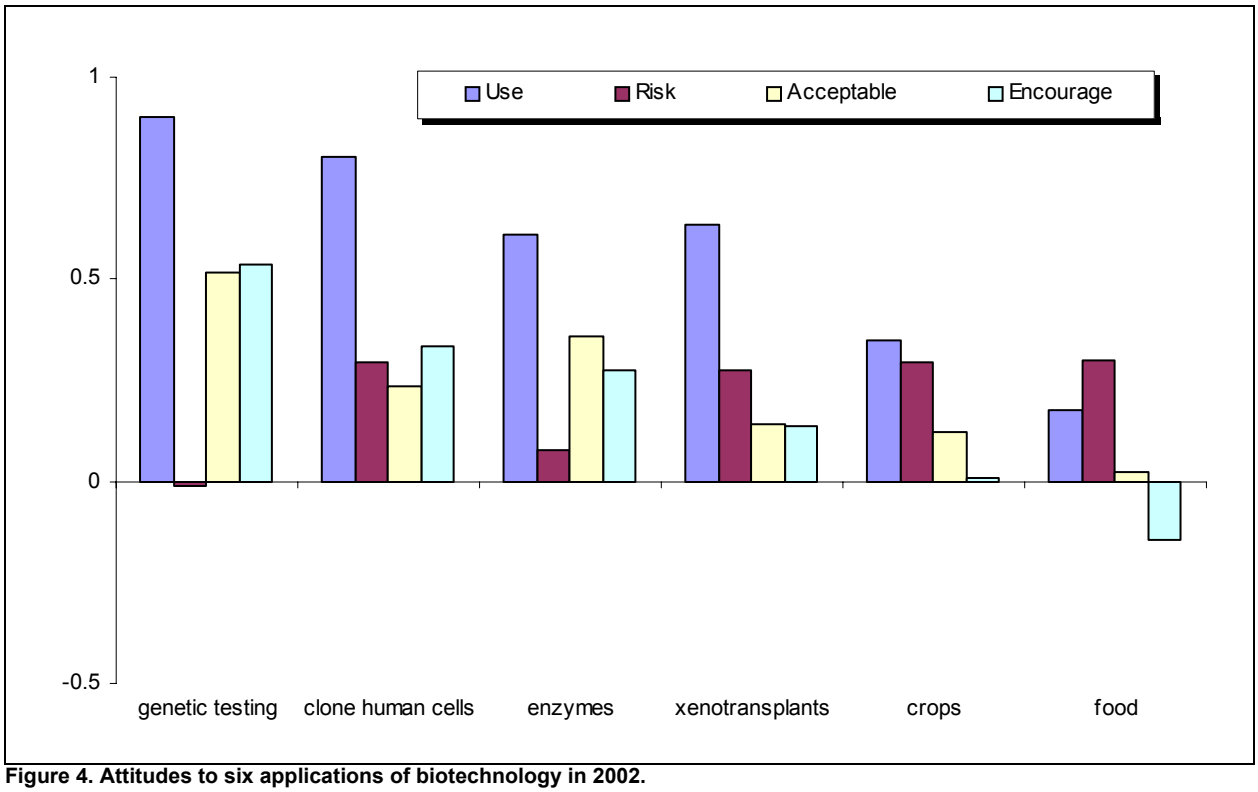

Figure 4. Attitudes to six applications of biotechnology in 2002.

comparison to the other applications, genetic testing is seen as more useful, less risky, more morally acceptable, and more supported. (For the remainder of this report we use the terms *encourage* and *support* interchangeably.) On the far right of Figure 4, the average assessment of GM foods is on the positive side for use, combined with a high level of risk. This application is not seen as morally acceptable, and on average, the public is opposed. Genetically modified crops fare somewhat better—the higher perception of use combined with the same level of risks as GM foods leads overall to neither support nor opposition.

The distinction between medical (the so-called "red" biotechnologies) and agri-food (the so-called "green" biotechnologies) is apparent. The red biotechnologies—genetic testing for inherited diseases and the cloning of human cells and tissue to combat conditions like Parkinson's disease and diabetes—are widely supported. Contrary to what might be expected, the term "cloning" does not lead to automatic rejection. In 1999, we found that cloning animals was widely rejected. However, when cloning is employed in an application that is seen to be useful, people are prepared to discount the risks and affirm support.

The green biotechnologies attract much less support. The majority does not support GM foods, and GM crops gain only very modest support. Greater opposition to GM foods over GM crops suggests that the public may be more concerned about food safety than about the environmental impacts of agri-food biotechnologies. This is not to say that they lack environmental concerns. The industrial application of biotechnology—the production of GM enzymes for environmentally friendly soaps—is judged to be useful and is supported by a majority. Finally, in the case of xenotransplantation, the benefits are seen as much greater than the risks, leading to a modest level of support.

Across the six applications considered, the relative level of benefits and risks seems to be an important driver of public attitudes. As the benefits are increasingly seen to outweigh the risks, so is there more support. However, where the risks are seen to outweigh the benefits, then there is opposition—as in the case of GM foods. It is worth noting that when people talk about risk, this is a broader category than the scientific definition (Gaskell & Allum, 2001; Gaskell, Allum et al., 2001; Thompson & Dean, 1996; Jasanoff, 1999; Rohrmann, 1999; Slovic et al., 1980). In the public mind, risks go beyond issues of health to include moral haz-

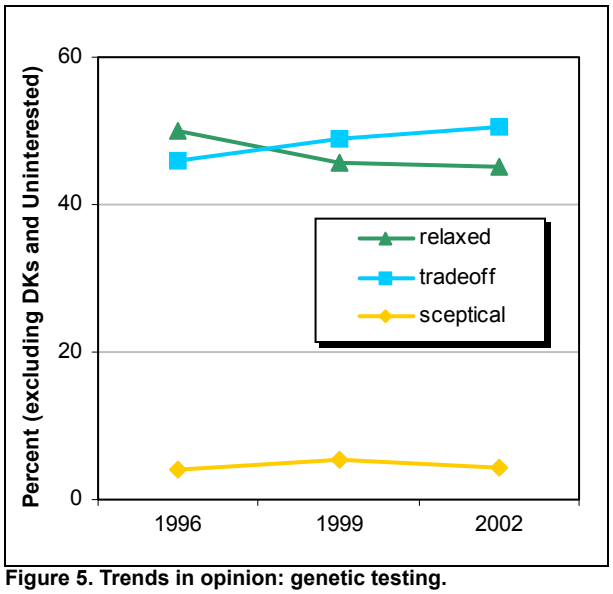

Figure 5. Trends in opinion: genetic testing.

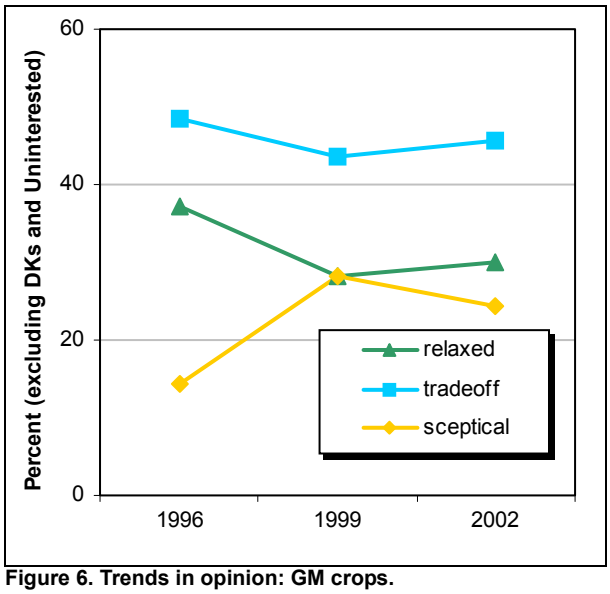

Figure 6. Trends in opinion: GM crops.

ards (is it right to do this?), democratic hazards (who is funding and controlling biotechnology?), and uncertainties (will there be as yet unknown adverse consequences?).

The Development of Attitudes to Applications of Biotechnology: 1996–2002

An economical and informative way to chart the development of attitudes over the period of 1996–2002 is based on groups of the public that differ in their perceptions of benefits and risks, as follows:

- The *relaxed group* thinks that a particular application is useful (has benefits) and has no associated risks. We would expect this group to be supportive of the application.
- The *skeptical group* thinks that a particular application carries risks but no benefits. As such, we would expect this group to oppose the application.
- The *trade-off group* thinks that a particular application has both benefits and carries risks. Whether members of this group would be supporters or opponents would depend on the relative levels of benefits and risks and perhaps other considerations beyond the scope of our surveys.
- The *uninterested group* sees the application as having neither benefits nor risks, and as such, we make no predictions about their views regarding support or opposition. However, because this group is relatively small in number, they are not included in the following analysis.

We present time series data (1996, 1999, and 2002) for those respondents that expressed an opinion about three applications of biotechnology: from the medical domain, genetic testing for inherited diseases, and from agri-food biotechnologies, GM crops and GM foods.

Here we find a very stable pattern of attitudes over the period. The skeptical group (risks and no benefits) was around 5%. The remainder of the public (excluding "don't knows") were almost evenly split (around 45–50%) between the relaxed group (benefit and no risk) and the trade-off group (benefit and risk). There is a hint of a shift from the relaxed group to the trade-off group, suggesting that although benefits continued to be seen, possible risks were increasingly recognized. How does this translate in terms of support? With 81% of the trade-off group deciding that on balance, the benefits outweigh the costs, the overall level of support for genetic testing (excluding the "don't know" respondents and the uninterested) was 81%. Note that it is a coincidence that this is the same percentage as the percentage of the trade-off group opting for support.

Over the period, the trade-off group was relatively stable at just under 50%. However, for the relaxed and skeptical groups, we see the impact of the watershed years of 1996–1999. In this period of controversy, the relaxed group declined by about 10%, while the skeptical group increased by 15%. Risks associated with GM crops and the absence of benefits clearly became more prominent public concerns. Although there was relatively little change in the period 1999–2002, there is a hint that both the relaxed and trade-off groups were on

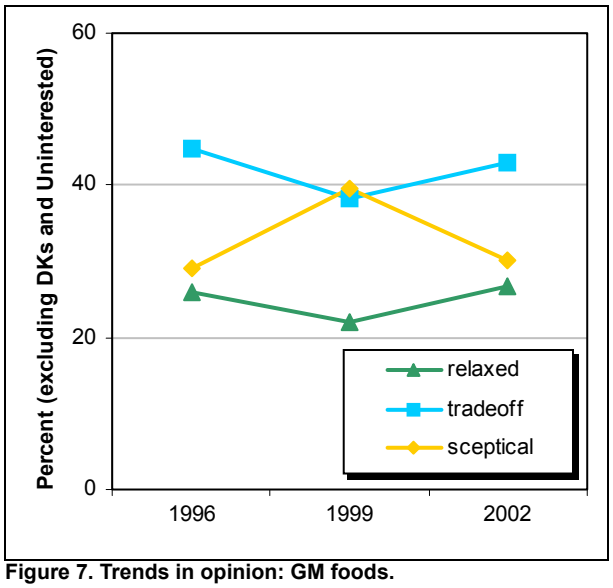

Figure 7. Trends in opinion: GM foods.

the increase. Overall, in 2002, of those that expressed an opinion, we find 45% in the trade-off group, 30% in the relaxed group, and 27% in the skeptical group. How does this translate into support for GM crops? With 66% of the trade-off group opting for support, there was a majority of supporters for GM crops—58% in favor and 42% against. This compares with support of 51% in 1999 and 71% in 1996.

As with GM crops, the impact of the watershed years is apparent. From 1996 through 1999, the size of the trade-off and relaxed groups declined, indicating increased doubts about the benefits of GM foods. The skeptical group, who see risks and no benefits, showed a 12% increase. From 1999 through 2002, all of the groups reverted to their approximate position in 1996. Hence, in 2002, 27% were skeptical about GM foods—31% in the relaxed group and 43% in the trade-off group. As to the distribution of support and opposition to GM foods, with 66% of the trade-off group opting for support, the public (excluding "don't knows" and the uninterested) were divided on the issue: 50% supported GM foods and 50% opposed. This compares with support of 39% in 1999 and 53% in 1996.

Commentary on Public Attitudes, 1996–2002

Looking at the trajectories of the three selected applications, some general observations can be made. The controversial watershed years of 1996–1999 had a substantial impact on public attitudes to agri-food biotechnologies. However, there is no apparent evidence of an effect of these controversies on support for the medical application of genetic testing for inherited diseases. The reason why, in all probability, is because the benefits of genetic testing and some other medical biotechnologies were not in doubt. The same can hardly be said for GM foods and crops.

Table 1. Menacing images of food biotechnology in Europe, 1996–2002.

	Percent correct		
	1996	1999	2002
1. Ordinary tomatoes do not contain genes, whereas genetically modified tomatoes do.	22	29	26
2. By eating a genetically modified fruit, a person's genes could also become modified.	15	22	15
3. Genetically modified animals are always bigger than ordinary ones.	27	23	26

From 1999 to 2002, all three applications show an increase in the size of the trade-off group—those who see the applications having both benefits and risks. This counters one common criticism of the public: that they want to live in a risk-free world. It is noteworthy that changes in levels of support for GM foods and GM crops parallel the changes in optimism about biotechnology as a whole.

What Lies Behind Opposition to GM Foods?

As noted earlier, people were disturbed by the idea of genetic modification in the late 1970s. We noticed similar concerns in 1995 during the conduct of some focus group interviews. We adapted these concerns into three survey questions addressing what we called "menacing images." Table 1 shows the questions and the percentages of the public who agreed with them. On the one hand, agreement indicates an absence of knowledge about genetics; but perhaps more significantly, it shows an inclination to agree to the idea that food biotechnology is associated with adulteration (q1), infection (q2), and monstrosities (q3)—the archetypes of eating anxieties.

On the three questions tapping menacing images, the percentage of correct responses was q1, 34%; q2, 54%; and q3, 37%. These results were not dissimilar to the corresponding European averages.

The fact that around 20% of the public assented to these menacing image propositions does not necessarily mean that they actively held such views before being asked the question in the survey interview. It is likely that many would not have thought about the issue

before. A more realistic interpretation is that when asked these questions about the unfamiliar area of genetics, their general unease and possible anxieties about the technology led them to assume the worst when asked about specific issues. This is much the same process as stereotyping—if a stereotype as a general evaluation is negative, then the holder is likely to impute negativity to all specific aspects of the object in question, including those of which they were previously unaware. Such stereotypes are generally resistant to change, as may be the basic ideas that lie behind these menacing images of food biotechnology.

Trust, or what we prefer to call confidence, has been a feature in the controversies around biotechnology (Gaskell, Allum, et al., 2001). Without confidence in experts, it is argued, people may misperceive the risks and uncertainties and be swayed by the exaggerated claims of those opposing the technology (Freudenburg, 1993). Hence, risk communication by trusted experts has long been offered as the solution to the public's skepticism.

In the EB survey, respondents were asked this question: "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?" Subtracting the percentage of respondents who say "not doing a good job" from those saying "doing a good job" provides an index of a confidence. A positive score indicates a confidence surplus, whereas a negative score indicates a confidence deficit. Table 2 presents figures for the confidence surpluses and deficits for 1999 and 2002. ("Don't know" responses are excluded.)

In 2002, all the actors had a confidence surplus. More people thought that the actors involved in biotechnology were doing a good job than were doing a bad job. At the top of the confidence league were doctors, followed by consumer organizations and farmers. The change from 1999 to 2002 is perhaps most striking for industry and government, both of which moved from a confidence deficit in 1999 to a surplus in 2002. Interestingly, the same pattern is observed across the European Union. Although most of the actors were viewed with more confidence in 2002, there were three exceptions: Shops and newspapers/magazines fell by 5% and 4% respectively, and confidence in environmental organizations fell by 11%.

Could these shifts, particularly for environmental organizations, industry, and government, be related to the cooling of the debates over agri-food biotechnologies after 1999? As the public focus on biotechnology moved away from agri-foods to the human genome, stem cells, and other biomedical advances, environmental groups may have been less visible to the wider public, and actors such as industry and government more likely to be associated with the development and regulation the biomedical area. On the other hand, perhaps the direct action against field trials may have led some of the public to distance themselves from the environmental movement at a time when there was sympathy for the plight of farmers.

Table 2. Confidence in actors involved in biotechnology, 1999 and 2002.

	Percent expressing confidence	
	1999	2002
Medical doctors keeping an eye on the health implications of	42	59
Consumer organisations checking products of biotechnology	43	47
Farmers deciding which crops to grow	19	38
Shops making sure our food is safe	31	26
Environmental groups campaigning against	32	21
Industry developing new products with biotechnology	-10	19
Newspapers and magazines reporting on biotechnology	15	11
Our government in making regulations on biotechnology	-4	8

GM Foods: Hypothetical Purchasing Intentions

We know that the public is almost evenly split on whether to support GM foods or not. What about purchasing intentions? Respondents were asked whether they thought they would buy GM foods described as offering one of a number of particular benefits (for example, lower prices or reduced pesticide residues). Also included was a question as to whether they would mind eating foods with GM ingredients in a restaurant. Of course, these questions are hypothetical, and as has been found in other research, people tend to express "citizen" rather than "consumer" preferences.

As shown in Figure 8, less pesticide residue, more environmental friendliness, and better taste (only just) are persuasive for a majority. By contrast, the majority said they would mind if they found that they were eating a restaurant meal containing GM ingredients; less fat

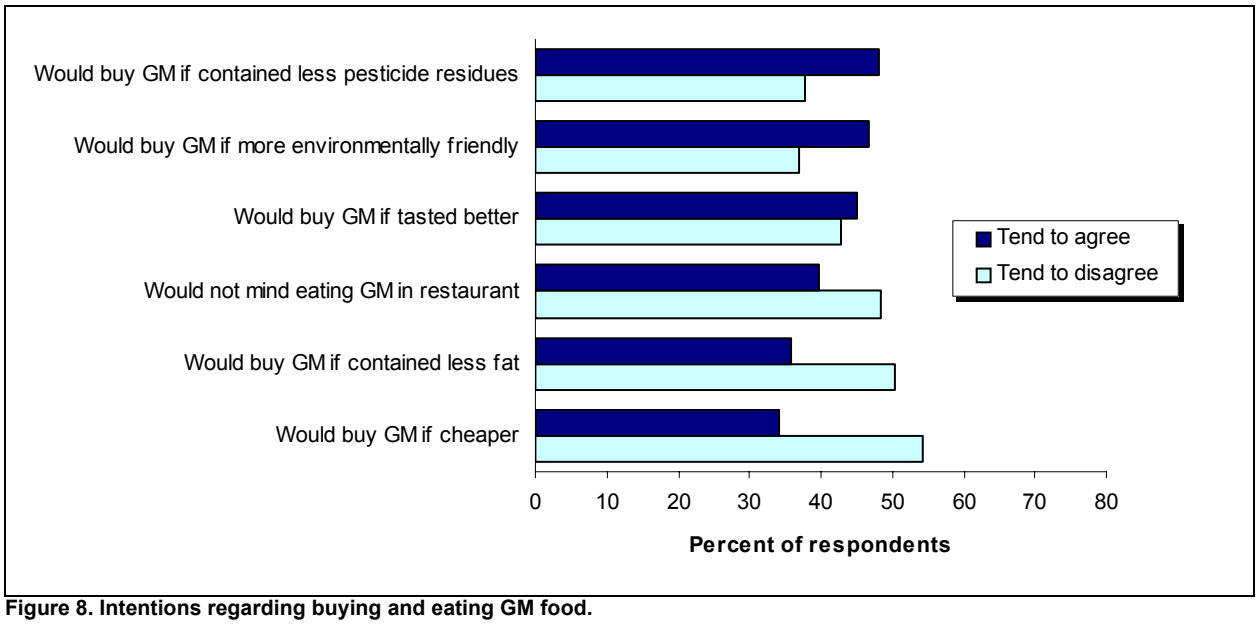

Figure 8. Intentions regarding buying and eating GM food.

and lower prices were not persuasive reasons. Somewhat surprisingly, of the range of benefits offered in this question set, a lower price was apparently the weakest incentive for buying GM foods. However, what people say and what they do are sometimes rather different—is this an example of people responding as "citizens" rather than as "consumers"? For example, when a canned tomato purée was marketed at a lower price and explicitly labeled as being made with genetically modified tomatoes, it sold well.

A second way of looking at these intentions is based on a count of the number of persuasive reasons accepted by each respondent. Figure 9 shows the distribution from the total rejecters on the left side to the enthusiasts on the right side.

What is remarkable about the distribution of intentions is that it is bipolar. The two largest categories are the rejecters at 32% and the enthusiasts at 24%, indicating that the public is divided on the issue. Furthermore, if we set aside the rejecters, the overall mean of persuasive reasons is 4.2. This suggests that although the rejecters operate a total veto, once a threshold of minimal acceptability is reached, then people are inclined to find quite a number of the reasons for buying GM foods persuasive.

Two interpretations of these results come to mind. On the one hand, given that the largest single category is the rejecters, this could be discussed in terms of the impossibility of introducing such new products. On the other hand, it could be argued that if GM foods actually

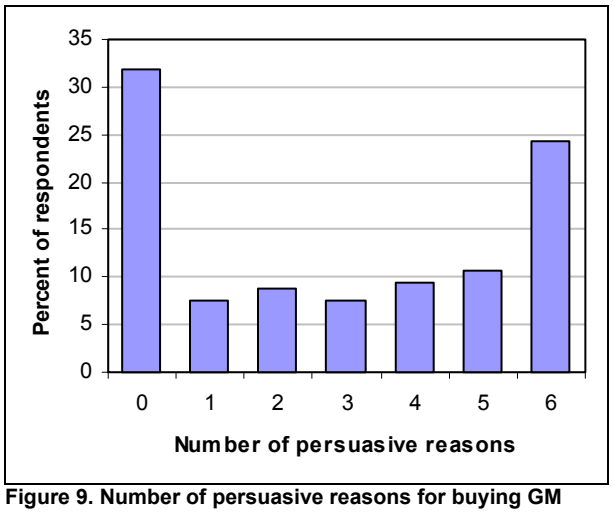

Figure 9. Number of persuasive reasons for buying GM food.

offered some of these benefits, and if they were labeled appropriately to give the rejecters the opportunity to express their preference, then such products might capture a sizable market share.

Characterizing the Rejecters and the Enthusiasts of GM Foods

What kind of people are the rejecters and the enthusiasts? The enthusiasts were more likely to be male and less than 25 years of age. By contrast, the rejecters were more likely to be female and more than 35 years of age. What kinds of attitudes and values are associated with

these groups? Enthusiasts tended to be more trusting of the food chain (seeing industry, government, and shops as doing a good job) and believe in free market economic values (e.g., they agreed to questions such as "economic growth brings better quality of life"). The rejecters had less confidence in the food chain and were more concerned about nature and the environment. They were more likely to agree with statements such as "nature is fragile and easily damaged." It appears that a combination of citizen (fundamental values) and consumer (confidence in food regulation, production, and distribution) concerns are likely to influence whether or not people would opt for GM foods.

Conclusion

The most recent Eurobarometer survey in 2002 showed the UK public to have become more optimistic about biotechnology and less opposed to GM crops and GM foods. Whereas a majority was opposed in 1999, a small majority now supports GM crops, and the public splits 50/50 on support for GM foods. This obvious ambivalence is reflected in the survey respondents' intentions about buying and eating GM foods. Some rejected them altogether; others acknowledged, for example, the benefits of lower pesticide residues, and still others seemed almost enthusiastic. There is now more confidence in industry and government compared to 1999.

What might account for this change in the public's view of agri-food biotechnologies? Could it be that the style of open governance adopted by the three new advisory bodies dealing with biotechnology has given people more confidence in the regulation of biotechnology? It is possible, but because most other European countries showed a similar rise in optimism between 1999 and 2002, there must be some pan-European issues involved.

Perhaps the de facto moratorium on the commercialization of GM crops of 1999 has taken the heat out of the controversy—the issue has drifted out of public consciousness. There has certainly been a fall in the volume of newspaper coverage after its peak in 1999. Moreover, as coverage has fallen, so has the evaluative tone become more positive.

Maybe the new provisions of the European Directive on deliberate releases (2001/18/EC)—the phasing out of antibiotic markers, transparency of risk assessments, more stringent follow-up evaluations, labeling, and so forth—have also contributed to reducing the level of controversy. The new provisions may have allayed the concerns of some oppositional groups, who in the past were influential in setting the agenda for some of the critical media coverage.

Related to the above, it is also possible that newspaper coverage has given more prominence to biomedical applications—the sequencing of the human genome, for example—and less to agri-food applications. Hence, in the public mind the connotation of the word "biotechnology" may have shifted towards the widely supported medical applications. Although this is possible, it would hardly account for the declining opposition to GM foods and GM crops.

It is important to note that an improvement in the climate of opinion for agri-food biotechnologies has occurred in more or less all the EU member states since 1999 (Gaskell et al., 2003). This cautions against parochial identification of causes unique to the UK and underscores the value of comparative research.

Implications for the UK "GM Nation?" Debate

What are the implications of this survey of UK public opinion for the current debate on GM agriculture and foods? Is the public ready to see the lifting of the moratorium on the commercialization of GM crops?

It is difficult to predict. Certainly, the climate of opinion for agri-food biotechnologies has improved since 1999, as evidenced by the findings of Eurobarometer 2002. Had the (recently resolved) issue of labeling been agreed upon in the middle 1990s, maybe the controversies of the watershed years would have been avoided. We must recognize that the current climate of opinion is a synthesis of past events both directly and indirectly related to biotechnology. Public concerns about genetic modification were apparent as early as 1979, but these were largely ignored by industry and government. These nascent concerns were fueled by fears over BSE and other food scares and evolved into opposition as the GM debate became public and political. Industry and government were held responsible by a skeptical public. That said, confidence in industry and government is now somewhat greater. Yet, the public is not the only actor to consider. The major food chains act as gatekeepers for consumers and a proxy for public opinion. It will only take one of the major supermarket chains announcing a GM-free policy to prolong the moratorium by other means through the market mechanism.

The basic problem with GM food remains the difficulty of delivering noticeable consumer benefits from the current GM commodity crops. These crops may well be beneficial for the seed companies, farmers, and food

producers and appear to be an important scientific innovation. However, people who think that GM ingredients in foods pose risks or uncertainties are unlikely to be persuaded without some counterbalancing perception of benefits (Gaskell et al., in press). That said, we have evidence from another of our surveys that a large section of the public has an open mind on the issue. In November 2002, people were asked which of four statements best reflected their position; 21% selected a statement that opposed the development of GM foods, whereas 6% chose a statement that was supportive. However, what is interesting is that 37% selected the statement, "I am generally in favor but could be persuaded against if I thought it was not safe" and 36% selected "I am generally opposed but could be persuaded in favor if I thought it was safe." Clearly, there is a role for public discussions.

Finally, what of public consultation? It is notable that many of the scientific issues discussed under the umbrella of "GM Nation?" seem to bear a close resemblance to the topics considered at the first national consensus conference on plant biotechnology in 1994. Plus ça change..., as they say. However, the reason for this may be that the real issue is not science per se, but rather the type of society that new developments in science and technology make possible. Few would argue that if something is technically feasible it should go ahead regardless. Some of the possible applications of biotechnology (for example, cloning humans in a similar fashion to Dolly the Sheep) are almost universally ruled out of court. For other applications, there is less certainty. Moreover, here the conflicts that emerge are about the fundamental questions, "what sort of society do we want, and how can new technology help in achieving it?" These are questions about ethics and social values; science alone cannot answer them. In this sense, any platform of public debate between autonomous and responsible citizens is to be applauded. And if socially sustainable technological innovation is a societal goal, appropriate platforms for such debates will need to be established (on nanotechnology, for example) if we are to avoid reliving the type of conflicts that raged over biotechnology in the middle to late 1990s.

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