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A module on measuring social issues as concerns biotechnology

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Structure of the presentation

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The task to present a proposal for a module on measuring social issues as concerns biotechnology was allocated to a group consisting of Dr. Karen Siune from the Danish Institute for Studies in Research and Research Policy in Denmark, Dr. Rhona Dempsey from FORFAS, Ireland and Mr. Seizo Sumida from Japan.

This paper is primarily based on experiences from Denmark, but it also includes experiences from Eurobarometers and from European discussions of biotechnology as an issue.

Comments from Mr. Sumida and Ms. Dempsey are welcome.

1. Social issues. What is a social issue?

An issue is a controversial point (Webster Dictionary), and according to a political science dictionary 'a social issue' is a controversial point, which is an object for social discussion.
Social issues is a wide concept that is used as a label for all kinds of social problems being discussed in public, but the concept is most often used for aspects of topics or themes that are under intense public debate.

Social issues are among political scientists defined as questions, which due to lack of general agreement are debated in public, that will say debated in the mass media and or among citizens. Today many issues are debated in the electronic media like the Internet, and discussions on the Internet will also indicate a degree of public debate, but not necessarily a social debate.

So when asked about ideas for a module on measuring social issues as concerns biotechnology, it is necessary to discuss:

a) Is biotechnology to be considered as a controversial point?
b) Is biotechnology an object for social discussion?

Both of these questions will for most of the OECD countries be answered with a yes, but one of the first questions is whether that is the situation in all OECD countries. The degree to which biotechnology is a controversial point varies from country to country, that is the hypotheses so far.

A third question can be added: Where does the debate take place? Can we really label the debate about biotechnology 'a social debate', and is it not just an issue among the elite, be it researchers or politicians?

Before that discussion it is necessary to look a little more at the question: What makes some issues social issues more than other issues?

There are many controversies never discussed in public, issues that will never be an object for social discussion. Some of these issues are discussed in politics, but in this task the concentration is on social issues.

2. What creates social issues?

A controversy cannot be an issue, and definitely not a social issue, unless there exist some kind of awareness of the issue. Public awareness can be created by the mass media and audience awareness is the prime example of the mass medias' agenda-setting impact. Knowledge gain and attitude formation are found to be later in the order of impact, according to impact studies done within the field of mass communication.

Viewpoints expressed on the mass media, that is on television, on radio or in newspapers, can draw attention to a specific topic, and statements transmitted by the mass media give at the same time input to an opinion formation within the actual audience, be they readers, listeners or viewers.

Different expectations connected to a specific topic or to a specific action are often the aspect of a given issue that makes it an object for discussion. Positive and negative expectations to a given object, a given development, can foster hectic social discussion. But before positive and negative expectations are formed, there must be some kind of delimitation of what "it" (the topic/ the object/the talking) is all about. What is behind the label x?

Sometimes albeit the public does not know or do not have a clear perception of what it is all about, it is enough to raise an unspecified question to get indications of a direction of the attitudes related to the object in the question, be they positive or negative; but often it is necessary or at least extremely relevant to add qualifying statements of the type: "positive for economic growth", "negative for individual freedom" or vice versa together with a lot of other qualifying options.

Citizens' attitudes to biotechnology is an example of a social issue! Citizens attitudes to biotechnology is considered to be a social issue in the form just defined, since research in biotechnology has been an object for public as well as private discussion, and there is so far no general agreement about the issue in the public. Citizens have expressed attitudes, stated in form of letters to newspapers as well as in letters to party representatives.

Preliminary studies on biotechnology as an issue have shown that biotechnology as an issue has been discussed in some countries more than in others, an aspect which by itself must be a relevant aspect worth attention for an OECD. Research in biotechnology is nevertheless not just an issue among researchers or industrialist representing companies doing work in biotechnology. And it is not only an issue among science councils or ethical councils, like those that are established for instance in Denmark.

3. Measuring social issues

The degree to which an issue is discussed in public is usually defined in comparison with other potential issues. Who discusses what in which media? What is on the public agenda? And what are the changes over time in the intensity of the discussion of the given agenda, or what are the changes in the agenda?

Social issues can be defined by looking at the media! What are the issues treated by journalists, in the news and in more in-depth articles? And what are the issues treated in the letters from readers to the newspapers? What are the issues treated in editorials? All these measures have been applied in studies of many and different social issues! In this respect, it is relevant to consider, whether the social issues depicted in the media are primarily short-term high-profiled social issues or if the media agenda can also be seen as a valid indicator of long-term social issues.

Knowledge about issues can also be gained from interviewing individuals face to face! In- depth interviewing might give an indication of the variety of perceptions and attitudes as well as an indication of intensity!

But if the object for consideration is the character of the potential SOCIAL ISSUE of biotechnology, valid information about biotechnology (as a real or potential social issue) can only be found using representative surveys of citizens! Surveys should be conducted repeatedly to disclose the long-term developments or trends concerning biotechnology as a social issue.

To what degree are citizens able to express their thoughts when asked about biotechnology and research in biotechnology? Ability to indicate attitudes requires some kind of perception, some kind of idea about what they / you are reflecting upon.

Experiences defined in form of results from surveys show that the mind associations regarding biotechnology are very different among different categories of citizens.

Attitudes can be defined as positive or negative as well as they can be neutral. But biotechnology as a social issue involves more than just attitudes. This is especially the case since biotechnology in the mind of the public is not so clearly defined as many other social issues.

Citizens, not only in Denmark, Ireland and Japan, actually in most OECD countries, have only vague perceptions of what the term biotechnology actually covers, but the vagueness and the lack of clear perceptions does not keep ordinary citizens from having attitudes. Citizens are here called ordinary citizens, if they have no special experience with biotechnology, as researchers, industrialists or anything like that. The majority in most countries is not aware of that they have special experience with biotechnology, neither in form of special knowledge of research in biotechnology nor in form of special experience with products, that in any way are modified by biotechnology.

Vagueness in perception of what biotechnology actually is, is outspoken as shown in several studies, and therefore the perceptions, the ideas and what comes to the mind of citizens, when asked about biotechnology, is extremely relevant, since the mental association to the word has shown to be leading

the attitudes. What is it citizens react upon, what is it they believe they are referring to when asked about biotechnology?

4. Public understanding of science

The concept ‘public understanding of science’ is open to many different interpretations. There is a lack of clear definition of ‘public understanding of science’, and it can be defined narrowly or broadly, and it cannot be separated from a host of other ethical, social, economic and political issues (Irwin, 1999).

But again awareness of science is a necessary ingredient, since without any kind of awareness of what science is among the respondents it is impossible to get meaningful responses in a survey, and even more necessary in a survey than in a study based on face to face interviewing.

It is therefore argued that it is meaningful to look into the degree to which biotechnology is at all mentioned as an element of science, albeit attitudes to biotechnology can exist totally isolated from any kind of perception of science.

The breath, the diversity and the contested definition of what public understanding is, is not necessarily a weakness, but it must be included in the planning of a module for measuring social issues as concerns biotechnology.

A relevant element in science studies of the concept of 'public understanding of science' is an assessment of the institutional conditions for involving citizens in questions concerning new technologies. In Denmark, several important actors play a role in involving the public in questions concerning the biotechnology sphere in terms of supplying information and creating opportunities for public assessment of developments in biotech R&D.

The Danish Board of Technology - that replaced The Technology Board (1985-1995) - is an independently organized government-initiated institution with the purpose to stimulate public debate about new technologies and advise Parliament on public assessment of different technologies.

The Danish Board of Technology arranges so-called 'consensus conferences' that engage citizens directly in the assessment of different technologies, including modern biotechnology. A group of 12-15 citizens are chosen to examine a specific controversial technological issue that has broader societal consequences. The citizen panel points out important perspectives to discuss, they cross-examine relevant experts in the field, and they then arrive at a consensus position. The outcome of the process is presented to policymakers and the public.

The citizen-based consensus conference is a Danish invention, and it has been adopted by a number of countries as an efficient model of direct public participation in questions concerning the consequences of new technologies in society. Several consensus conferences have been held in Denmark on issues relating to biotechnology. The Danish Board of Technology also engages in other activities aimed at informing and involving citizens on technology issues, ranging from perspective workshops and role plays to hearings in parliament and the publication of reports and books on issues of interest to the general public.

Another important institution is The Danish Council of Ethics, created by statute in 1988, with the assignment of advising and informing Parliament and citizens about ethical problems raised by developments within the national health service and the field of biomedicine. The council has published a series of books on ethical dimensions in relation to biotechnology and financially supports public meetings and seminars on ethical aspects of biotechnology.

From the middle of the 1980s the NGO NOAH actively has raised questions concerning the utilisation of GMOs in the production of insulin and human growth hormone. NOAH was the first NGO opposing modern biotechnology, and also important as a source of information on the subject, supplying the public with knowledge about genetic engineering. In a series of publications Noah has described and discussed research in biotechnology and the prospects and applications of industrial products involving GMOs. Other NGOs such as 'Active Consumers' (Danmarks Aktive Forbrugere) and Greenpeace have also since been involved in raising a critical voice on behalf of the general public,

not least regarding the perceived health-risks of GM food, and the question of whether or not to label genetically manipulated food products.

The NGOs have contributed to stimulating public debate, as have the media. Examining the intensity and character of media coverage of biotechnology, Jelsøe et al. (1998) conclude that there has been a continuing educational aspect of media coverage through the last decades, even though the proportion of informative articles has declined over the years. Through the 1990s fewer articles dealt with a general questioning of gene technology. Instead, especially at the end of the 1990s, the media engaged in critically discussing specific techniques and achievements that were now reality rather than hypothetical, such as the cloning of Dolly and Monsanto's Roundup-Ready soya.

The over-all impression is that there are relatively good conditions for public involvement in the debate concerning biotechnology in Denmark. There are several institutionalised channels of information from the biotechnology sphere and also a number of channels of influence from citizens towards biotechnology. It must be added that some degree of non-formalized engagement in the debate about biotechnology also appears in Denmark, such as the sudden protest gatherings in connection to the first arrivals of GM foods in Denmark.

The Eurobarometer analysis of European citizens' perceptions of biotechnology indicates that public debate and information flow regarding biotechnology are fairly inclusive in Denmark. The average general knowledge of biotechnology is high in Denmark in comparison with other European countries. In 1996 the average score on the biotech knowledge index of Danish respondents was only surpassed by the Netherlands.

5. Biotechnology: what is it?

In the discussions about biotechnology there is a lot of verbal as well as written references to biotechnology, but very seldom there is included in the discussion a clear definition of what biotechnology is, nor references to what it is perceived as.

Among statisticians it is a well-known fact that definitions of the object we try to measure are absolutely necessary, and this section of the paper will focus on different definitions used by individual OECD countries. The emphasises in the different definitions diverge; some refer to:

• *Science and Industry*, others to
• *Science and Society*, and the latest to
• *The knowledge society.*

There is a clear differentiation between definitions that emphasize the society perspective in form of references to relationship between science and society or refer to the specific society labeled as the ‘knowledge society’ and those definitions that refer primarily to science and industry. Those definitions that refer to goods and services are classified in this presentation as being of the type with reference to science and industry. The definitions used by OECD and the European Federation of Biotechnology are examples of such definitions that refer both to services and to products or goods.

OECD: *Biotechnology is the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services.*

European Federation of Biotechnology: *Biotechnology is the integration of natural sciences and engineering sciences in order to achieve the application of organisms, cells, parts thereof and molecular analogues for products and services.*

The Danish definition also refers to industrial production but at the same time it refers to societal aspects such as environment, and with the inclusion of this aspect the definition change from pure industrial orientation towards the integration of science and society albeit the majority of the definition is concerned with industrial production.

Denmark: *Biotechnology is the integration of natural sciences and engineering sciences in order to develop and produce organisms, cells, and molecular analogues for the combating of disease, environmental improvement, food production, energy production, and industrial production.*

Contrary to the orientation presented in that definition the definition presented by New Zealand refers primarily to “improving quality of life”. And the same approach is presented in the Australian definition, which refers to technological application “useful to mankind”.

New Zealand: *The application of scientific and engineering principles to the processing of material by biological agents and the processing of biological materials to improve the quality of life.*
Australia: *Biotechnology means any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use. Biotechnology is simply the use of micro-organisms, and plant and animal cells, to produce materials such as food, medicine and chemicals that are useful to mankind.*
In OECD at ad hoc meetings in 200 and 2001 within a working group attached to NESTI (The National Experts on Statistical Indicators) the discussion has dealt with the possibility of finding a definition that could be used as a basis for collecting data for statistical comparisons. The single definition agreed upon at the 2001 meeting in the ad hoc group is shown below. This definition refers to ‘knowledge, goods and services’ and in this way it embraces all the above mentioned aspects: the industrial production of goods, the new economy-perspective of services and refers to knowledge as well; and the last item transfer the definition to the class of definitions that does not only focus on the industrial or economic aspect of biotechnology.

Provisional single definition (OECD, 2001, Ad hoc study group): *The application of S&T to living organisms as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.*
But the single definition presented did not, albeit it included so much and so many aspects of biotechnology, give enough specification to what biotechnology actually is, so in addition to the single definition a list based definition was added.

Additional list based definition (OECD):

- *1. DNA (the codings): genomics, pharmaco-genetics, gene probes, DNA sequencing/synthesis/amplification, genetic engineering*
- *2. Proteins and molecules (the functional blocks): protein/peptide sequencing/synthesis, lipid/protein engineering, proteomics, hormones and growth factors, cell receptors/signalling/pheromones*
- *3. Cell and tissue culture and engineering: cell tissue culture, tissue enginering, hybridisation,cellular fusion, vaccine/immune stimulants, embryo manipulation*
- *4. Process biotechnologies: Bioreactors, fermentation, bioprocessing, bioleaching, bio-pulping, bio-bleaching, biodesulphurization, bioremediation and biofiltration*
- *5. Subcellular organisms: gene therapy, viral vectors*It is obvious from a reading of the processes included in the additional list, that it is or at least may be functional for producers or for researchers working with biotechnology, but it is also obvious, that it can never be used in social discussions of biotechnology. In social discussions it is expected that there will be references to examples of biotechnology, but no one without expert knowledge will be able to apply the list based definitions, so the conclusion is, that it might prove relevant for statistical purposes. And the conclusion is also that it includes what we care about, but it does not necessarily improve social understanding of biotechnology and nor can it be expected to make discussion of biotechnology as a social issue easier. The definitions are not meant for public use, but for use in statistics, and hence they are not fit for testing ‘biotechnology as a social issue’.

6. Experiences from a UK-Nordic co-operative seminar, 1998

Looked at from the perspective of social science, and especially from that of a social science that does not simply diminish public concerns but aims to give these serious attention, this area can be difficult to pin down and analyse. What theoretical and empirical tools are at our disposal in tackling these difficult topics? Papers presented at the seminar on Biotechnology and Public Understanding of Science held on October 25-27, 1998, in Helsinki, refer to how much can be learned from the study of different experiences - and expertises - in this important area of research and practice.

Regarding the public understanding of science Miettinen and Väliverronen show that the Finnish people seem to be fairly more confident on the role of science and technology in solving environmental problems in the future than citizens in other western European countries. The Eurobarometers on biotechnology show similar results. According to the Eurobarometers the Finns are more optimistic about biotechnology, but these surveys are of course vulnerable to deconstruction (on the problems in biotechnology surveys, see Hill & Michael 1998). Most surveys do not take into account the different kinds of public understanding of science and the Eurobarometer surveys revealed that the Finns, who are positive towards biotechnology, are at the same time among the most critical towards genetic engineering. In Finland science is typically considered a positive social and economic force in the context of a unitary nation state. In the 1990s, the consensus seeking national policy in Finland has taken science and technology policy as one of its major themes, and the R&D funding has increased rapidly in Finland. It is being focused more on the technical sciences than in other Nordic countries. The orientation towards high technology and industrial innovation can also be seen in the organization of R&D funding, and these issues must be seen in the interplay they actually are engaged in.

7. Eurobarometers

Four special Eurobarometers on public understanding of biotechnology has been conducted during the 1990s. The Eurobarometers on biotechnology from 1996 and 1999 leave the impression that the expectations towards this area of research have decreased. Table 1 shows the difference in per cent point between those who expect new technologies to improve our way of living within the next twenty years and those who expect the new technologies to make things worse.

Table 1: Expectations towards new technologies; will improve life - will worsen life (difference in per cent point)

	EU15 1996	EU15 1999
Solar energy	69	67
Computers & information technology	68	74
Biotechnology	36	27
Genetic engineering	19	9
Telecommunications	78	78
New materials or substances	58	57
Space exploration	42	43

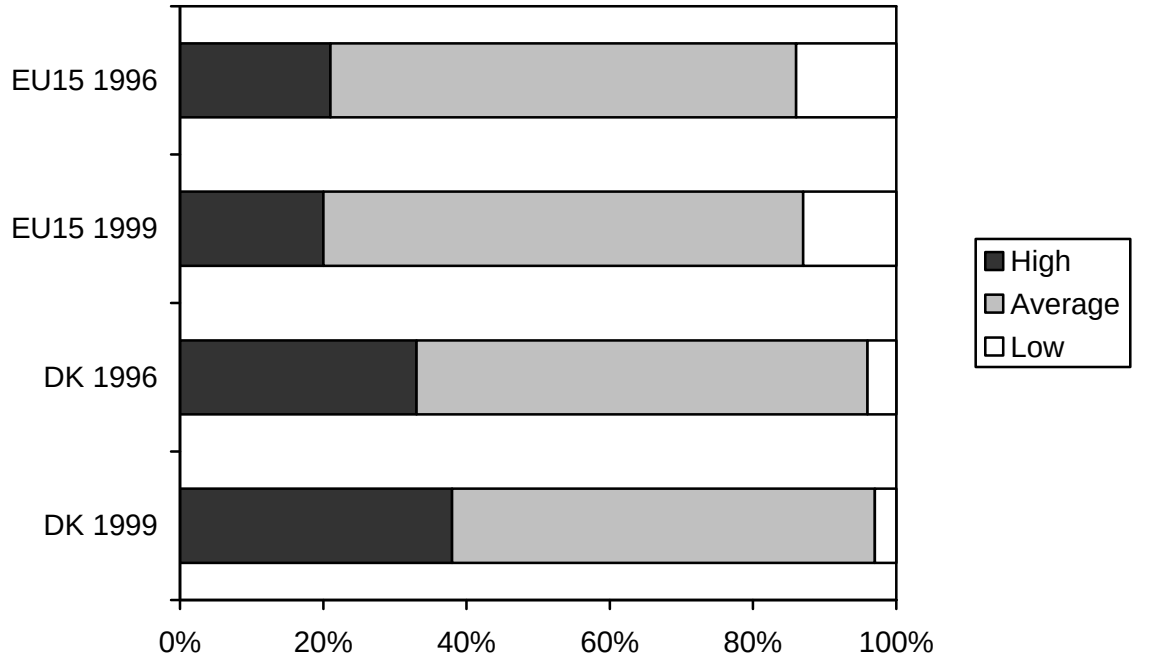
Table 1 shows that expectations towards biotechnology and genetic engineering have decreased noticeably over the three years period. There is also a moderate decrease in net positive expectations towards solar energy and new materials or substances, whereas positive expectations towards computer & information technology and space exploration have increased.

The difference between expectations towards biotechnology and genetic engineering, with expectations concerning biotechnology being highest, is an interesting result achieved by split balloting the question in the Eurobarometers. The results of the Danish AFSK 2000 survey show that not only do citizens perceive of 'biotechnology' and 'genetic engineering' differently regarding the promises and risks they hold; the very words also set in motion qualitatively different lines of associations amongst respondents (see below).

Ever since The National Science Foundation performed the first systematic surveys on public understanding of science in the 50s, special attention has been paid to producing valid measurement of citizens' level of 'objective knowledge' of science and research. In the first decades of the empirical research programmes the dominant expectation of scientists and politicians involved with science policy was to find a relationship between a high level of knowledge on the one hand and a positive attitude towards science on the other. The political presupposition regarding the public support for science suggested that any lack of support could bed explained by a lack of information or knowledge about scientific practices or research results. Within the theoretical framework this relationship between knowledge and support - or lack of support - is known as the 'model of deficit', and in several ways the model of deficit has set the agenda not only concerning the empirical work within the field, but also regarding the political initiatives within this policy-area.

The Eurobarometres on public understanding of biotechnology from 1996 and 1999 encompass nine questions aiming at measuring the respondents' level of factual knowledge about modern biotechnology. Building an additive index based on those questions enables us to divide the respondents into categories according to their level of factual knowledge. Figure x suggests that the Danish segment of respondents is generally well informed compared to the average European citizen. During the three-year period from 1996 to 1999 the average score on the knowledge-index has even increased moderately from 5,7 to 5,9 amongst the Danish respondents, whereas the European average is 4,8 both years.

Figure 1: Level of factual knowledge of modern biotechnology; per cent.



The Eurobarometres suggest that knowledge is in fact related to attitudes. First, respondents with a high level of factual knowledge are most likely to hold strong opinions about biotechnology; positive opinions as well as negative ones. This does not correspond with the model of deficit that would have expected only positive attitudes to increase as knowledge increases. Secondly, when excluding those respondents who have no opinion about biotechnology, there is in fact a positive correlation between knowledge and attitudes. This means that, when looking only upon those persons who have an opinion regarding biotechnology, there is some validity to the model of deficit.

Thus, the model of deficit cannot be rejected when looking upon the relationship between knowledge and attitudes in an isolated manner. But it must be emphasized that factual knowledge is not the prime explanatory variable in regard to attitudes towards biotechnology. Further, even if knowledge has a

direct positive impact on attitudes, it also has a positive impact on risk-aversion, which, in turn, has a negative impact on attitudes on towards biotechnology. Risk-aversion increases as knowledge increases, which means that people tend to be more skeptical and less willing to accept risks the better informed they are. When risk-aversion increases attitudes towards biotechnology tend to be more negative. In sum, the net effect of increased knowledge is difficult to estimate, since the indirect impact on attitudes is neither exclusively positive nor exclusively negative. In other words, the model of deficit must be sophisticated in terms of including intermediate variables that are affected by the level of knowledge and affect attitudes towards biotechnology. Risk-perception is one such variable that is affected by the level of knowledge.

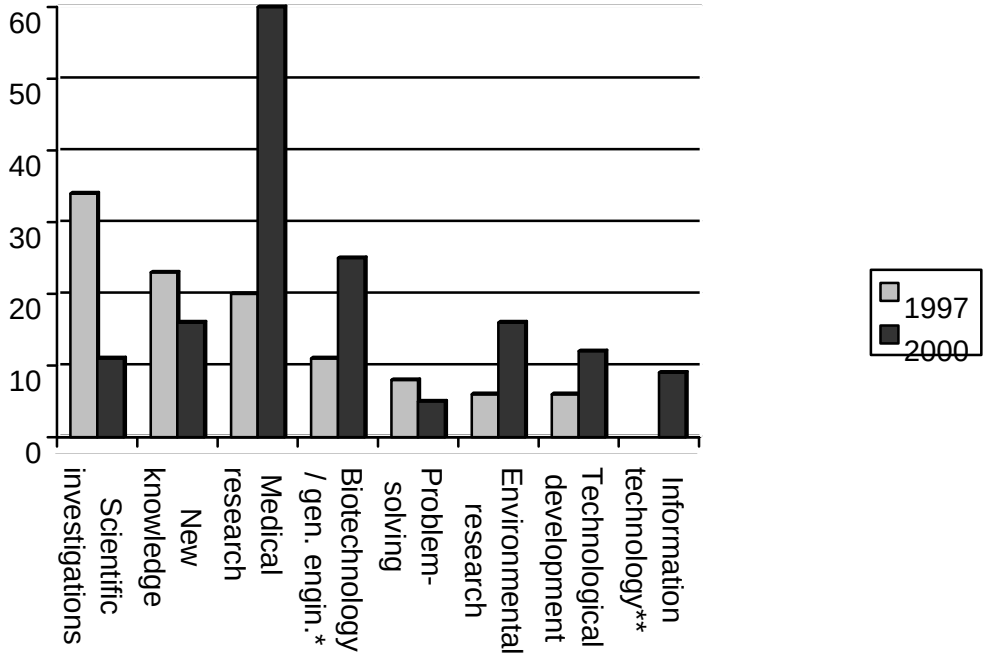
At the core of the 1996- and 1999 Eurobarometers is a question that reveals the respondent's assessment of risk, usefulness, and moral acceptability regarding specific applications of biotechnology, and estimates the respondent's willingness to encourage these applications. This 'item' in the questionnaire has proven to be a solid indicator of how attitudes towards biotechnology are constituted. In a cross-national research project this item was used to map different typical categories of citizens in terms of their position on the four dimensions (Durant et al. 1998). Perceptions of risk, usefulness and moral acceptability are important aspects of public understanding of biotechnology that must be taken into consideration when establishing predictive models of attitude formation in this area.

8. Danish experiences

Perceptions of science and research in general

When confronted with words such as 'science' and 'research' a range of specific research fields and broader terms come to the mind of Danish citizens. In 1997 there was a tendency to express perceptions in broad terms such as 'scientific investigations' or 'new knowledge', whereas in 2000 a significant share of respondents chooses to express perceptions in connection to research in terms of specific research fields such as 'medical research', 'biotechnology', or 'environmental research'.

Figure 2: Perceptions of science and research; per cent



* In the 2000-survey the categories 'Genetic engineering' and 'Biotechnology' are separate.
** The category 'Information technology' was not included in the 1997-survey.

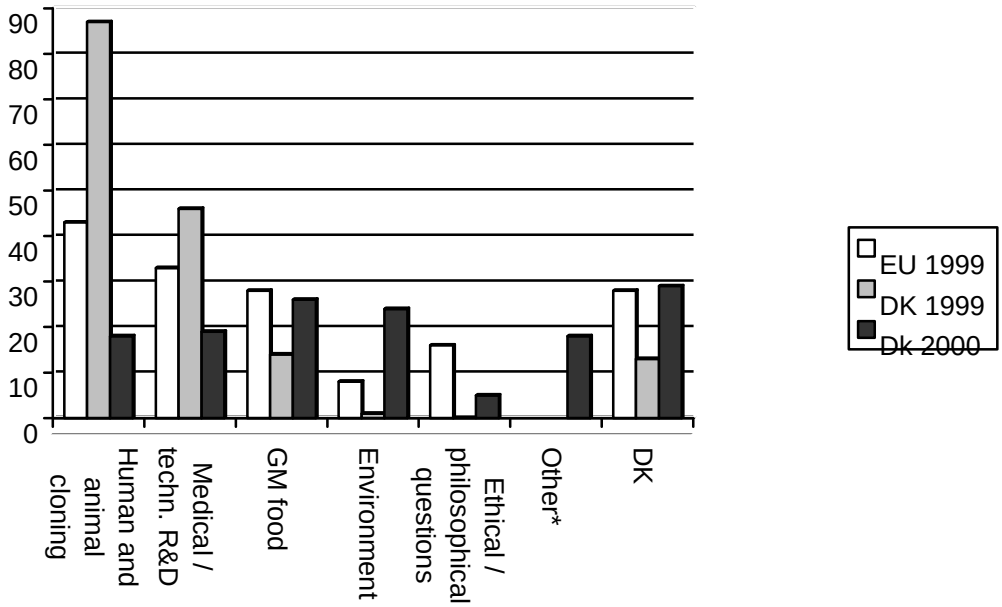
Figure 2 shows the distribution of perceptions on a number of categories for 1997 and 2000. It is noticeable that perceptions regarding 'biotechnology' or 'genetic engineering' have increased from 11 to 25 pct. over the three-year period. Unprovoked, 1 out of 4 respondents mentions biotechnology - or a related term - when asked what comes to mind when thinking about science and research in 2000. This is a rather high proportion of respondents, and it brings biotechnology into the second highest position regarding the distribution of perceptions of science and technology. Biotechnology is only outranked by 'medical research' that has a unique position in the minds of the Danish citizens. Medical research is also the research area that the Danes are most interested in and the area that the majority is in favour of prioritising in terms of increasing the public financing of research.

There is a statistically significant correlation between gender, age, and educational background on the one hand and perceptions of science and research within the area of biotechnology on the other. In 2000, women are more likely to think of biotechnology, when asked about perceptions of science and research, than are men. Young people are more likely to mention biotechnology than the elder, and the well-educated mention biotechnology more often than the less educated.

Perceptions of modern biotechnology

Taking the analyses one step further, we now examine the Danes' perceptions not of science and research in general, but of modern biotechnology in particular[1]. In the 2000 survey we asked respondents to express their immediate thoughts when thinking about modern biotechnology. The answers were distributed according to a preclassification of five categories, originating from the Eurobarometer surveys on biotechnology, and to the extent that answers could not reasonably be fitted into the categories, they were categorized as 'other'. The categories have been applied rather narrowly to respondent answers, resulting in a relatively large proportion of 'other'-answers. As a general methodological remark, it is surprising that respondent answers have fitted so neatly into five categories in the Eurobarometer surveys. In the 2000 survey even a very inclusive application of the categories would have left a number of answers that in no way fitted into the preclassification. The distribution of answers is shown in figure 3, where the black bars represent the results from the 2000 survey.

Figure 3: Perceptions of modern biotechnology; per cent



* The category 'other' is not included in the EB-survey.

[1] The term 'perceptions' could be used in a broad sense to cover the entire spectrum of public interest in, understanding of, thoughts about, and attitudes towards the research area. In this paper the term is used narrowly to describe the immediate thoughts and associations that spring to mind, when a person is confronted with the word 'biotechnology'.

Measuring perceptions
In figure 3 the white and grey bars represent results from the Eurobarometer survey 52.1, conducted ultimo 1999 in 15 states. The white bars illustrate the distribution of perceptions in the entire survey population, and the grey bars represent the Danish fragment of the survey population.

Comparing the Danish figures in 1999 and 2000 respectively illuminates remarkable differences. In 1999, 87 pct. of the Danish citizens thought of 'human and animal cloning' when asked about immediate perceptions of biotechnology, whereas the corresponding figure in 2000 is only 18 pct. People who think of 'medical research or scientific progress' are also strongly over represented in 1999 in comparison with 2000, whereas the share of respondent answers in the remaining three categories are higher in 2000 than in 1999. It is equally remarkable that only 13 pct. of respondents have no perceptions of biotechnology in 1999, whereas 29 pct. fit into this category in 2000.

In order to understand this apparently substantial development in perceptions of biotechnology in Denmark, a media surveillance has been performed for both survey periods, covering the time spectre from one month prior to the starting date for data collection up until the end of the survey period. For the Eurobarometer survey in 1999 this period is from October 1 to December 15, and for the 2000 survey the period is between September 9 and December 3. Three newspapers have been selected as indicative of the general topics on the public agenda, and the quantity and the contents of articles concerning biotechnology have been examined[2]. The amount of articles containing the words 'biotechnology', 'genetic engineering', 'cloning', or a combination of the three words are noted in table 2. Not all of the articles have modern biotechnology as their main subject, but in all articles words relating to biotechnology are used.

Table 2: Number of articles on biotechnology

	01.10.99 - 15.12.99	09.09.00 - 03.12.00
Biotechnology	21	39
Genetic engineering	73	30
Cloning	27	19
All words included	108	78

As shown, the total amount of articles with reference to the subject was large in 1999, and this result contributes to understanding the relatively higher proportion of respondents in 1999 having specific perceptions of biotechnology. The fact that only 13 pct. of the respondents have no perception of biotechnology, could be explained by the relatively higher density of media coverage in the period prior to and during the data collection. Biotechnology had a relatively higher position on the media's agenda in 1999.

What remains to be examined is the difference in the distribution of perceptions on the five categories between the 1999 survey and the 2000 survey. Concentrating on the category 'human and animal cloning', a closer look on the articles containing the word 'cloning' reveals that respectively 11 articles in 1999 and 10 in 2000 within the period prior to and during the interviewing actually deal with human and animal cloning as the major issue.

There are no severe differences in the contents of the articles that could lead to the conclusion that 'cloning' had a more prominent position on the public agenda in 1999 than in 2000. In both survey-periods a number of articles concerns general ethical questions related to human and animal cloning. In 1999 these articles were inspired by a conference arranged by the Danish Council of Ethics and the University of Copenhagen. In 2000 the articles on general ethical questions emanated from a hearing arranged by the Danish Board of Technology on therapeutic cloning.

In the 'news' category the 1999-articles describe the potential cloning of a mammoth grounded in the discovery - and transporting - of a 23.000 years old well-preserved mammoth in Siberia and the successful cloning of a calf in Texas. In 2000 the articles in the news category describe the

[2] The newspapers are Politiken, Information, and Jyllandsposten. The two first mentioned have in earlier studies been chosen as indicative of public debate in relation to political and economic decision-making (Jelsøe et al. 1998).

proclamation of an American cult that preparations are being made to do reproductive cloning of a human being and an approval by the EGE to do research in stem cells.

Even though the contents of the articles are obviously not the same in the two survey-periods, the content analysis finds no substantial evidence suggesting that cloning as a subject of public concern is of more importance in 1999 than in 2000. In order to explain the fundamental difference between the 1999 survey and the 2000 survey in perceptions tending towards cloning, the focus will thus be shifted towards the exact phrasing of the question posed to respondents in 1999 and 2000 respectively.

In the 2000 survey respondents were asked to answers the following question: *'Please tell me what comes to your mind, when you think of modern biotechnology in a broad sense?*'. In 1999 the exact same words had been used, but subsequently the sentence *'that is including genetic engineering*' had been added. In the Danish edition of the 1999 Eurobarometer-questionnaire used for the Danish segment of respondents, the words 'genetic engineering' were translated into 'gensplejsning' (gene splicing) which is a rather slim expression compared to 'genteknologi' (gene technology), which would have been an alternative Danish translation of 'genetic engineering'.

Taking into account that there was no particular focus on cloning in the media at the time of the 1999 survey, the massive intensity of associations regarding human and animal cloning amongst the Danish segment of respondents suggests that the phrase 'gensplejsning' sets in motion a line of associations in the direction of 'cloning'. In 2000, where respondents were asked of their thoughts regarding biotechnology in general, and the subsequent sentence *'that is including genetic engineering*' was excluded, there was a levelling between the categories of perceptions.

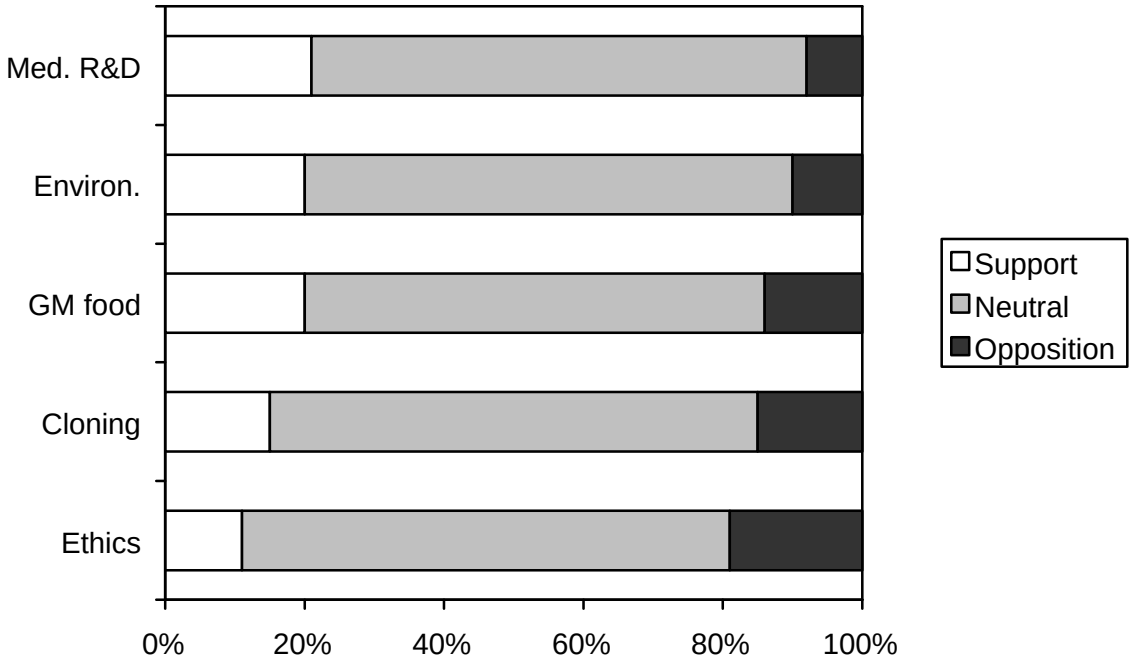
This comparison between the distribution of perceptions in 1999 and 2000 indicates that the way in which perceptions are operationalized is decisive for the result of the inquiry. It is unlikely that 87 pct. of the Danish population - everyone but three persons when excluding the respondents with no perceptions - should conceive of biotechnology in terms of cloning, unless they were exposed to a specific stimulus. It is somewhat more likely that 87 pct. of respondents think of cloning when guided by the word 'gensplejsning', and it must be emphasised that the 1999 survey in fact was measuring perceptions of genetic engineering rather than biotechnology.

Split ballot questions on expectations to biotechnology / genetic engineering respectively in the Eurobarometers through the 1990's are indeed suggestive of the importance of distinguishing between the words 'biotechnology' and 'genetic engineering' and the results presented here underscore the need of linguistic clarification in measuring perceptions.

The impact of perceptions on attitudes

Attitudes are clearly shown to be associated to perception of what biotechnology is. Figure 4 shows that, on average, people who perceive of biotechnology in terms of medical research are more supportive than respondents who associate biotechnology with GM food.

Figure 4: Perceptions and attitudes towards biotechnology; per cent



GM food is the area within the field of biotechnology that Danish citizens in 2000 most frequently mention when asked about perceptions of modern biotechnology. GM food is a subject of concern and interest in Denmark, which is also reflected in a relatively high level of both media coverage and research effort. It is interesting that among the respondents who perceive of biotechnology in terms of GM food there is the lowest share of 'neutral' attitudes towards biotechnology. Respondent answers indicate that an awareness about GM food provoke strong opinions regarding biotechnology in general.

Respondents who perceive of modern biotechnology in terms of 'human and animal cloning' or ''ethical/philosophical questions' are the least supportive of biotechnology in general, whereas perceptions of biotechnology in terms of 'medical research - technological development' or 'the environment' lead to the highest level of support for biotechnology in general.

The results of the Danish surveys are generally in accordance with the results of the Eurobarometer results. Factors such as risk-perception and perception of usefulness are also strongly correlated with attitude towards biotechnology in the Danish analysis. However, one single explanatory variable stands out in the Danish results as extremely important in predicting attitudes towards biotechnology. The Danish citizens' confidence or trust in scientists within the field of biotechnology is strongly correlated with attitudes towards biotechnology. Table 3 shows that citizens with no confidence in scientists are very likely to be negative towards biotechnology, whereas a high level of confidence generates a positive attitude towards biotechnology.

Table 3: Confidence in biotech scientists and attitudes; per cent.

	No confidence	Not much confidence	Some confidence	Much confidence	Total
Opposition	42	32	10	6	12
Neutral	54	64	72	65	70
Support	4	4	18	29	18
Total	100	100	100	100	100
N	26	161	880	275	1342

This means that attitudes are not solely constituted by an objective or calculated identification with the research field in question, but also - and strongly so - by a personal or emotional identification with the people engaged in scientific research within biotechnology. Biotechnology is an example of a field of research that has an enormous potential impact on society and will affect our social life in terms of developments within areas such as health, foods, environment and so forth, and the survey results suggest that trusting the people engaged in knowledge production within this field is an important precondition for public acceptance of modern biotechnology.

9. Recommendation for a module

Due to the character of the social issue it is not that easy to measure. Nevertheless it must be considered relevant to measure, and not only in the form of a summary of attitudes expressed in newspapers etc. Therefore it is recommended to make regular representative surveys.

It is recommended to measure general awareness of or interest in science and research, since this is considered an important precondition for public engagement in the debate about specific technologies such as modern biotechnology (Q2, Q5, Q6, Q7).

It is recommended to measure awareness of biotechnology as compared to awareness of other fields of research in order to asset public understanding of biotechnology in a broad perspective and enable comparisons between citizens' perception of different fields of research (Q1, Q3, Q4, Q6_1).

It is recommended to measure perceptions of what biotechnology is, and it can be argued that it is necessary, since surveys so far have shown that reactions and attitudes are very dependent of the perceptions respondents have. Ideally, perceptions should be operationalized as an open question with no pre-coded categories, even if it calls for subsequent recoding of respondent answers, since perceptions will develop over time and tend to be incompatible with the pre-coded categories. Unfortunately such an operationalization would be quite expensive and furthermore it would result in divergent national categories that would prevent comparison. For practical purposes, and to ensure comparability, it is recommended to pre-code a number of categories based on evidence of public perceptions from in-depth interviews and prior categorizations in surveys such as the Eurobarometers. The categories should not necessarily be exhaustive. Respondent answers that do not fit with the categories should be written down and recoded into complementary categories. It should be measured whether the different categories of perceptions have positive, neutral or negative connotations (Q8, Q8_1).

It is recommended to measure perception of risk, usefulness, moral acceptability (Q9, Q13), as well as level of factual knowledge (Q11) and trust in scientists and other actors on the biotech scene (Q11). These are all very important aspects of the public understanding of biotechnology and important explanatory factors concerning the general attitude towards biotechnology.

Finally, it is recommended to measure attitudes towards biotechnology both in terms of support of specific applications of biotechnology (Q9) and attitude towards a number of value statements (Q12). The respective items in Q12 have proven effective in constructing valid indexes of attitudes.

Background questions should include variables such as sex, age, education, research experience, income, religious affiliation, rural/urban area etc. In addition information about media habits should be requested (Q101, Q102, Q103).

10. Literature

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11. Draft questionnaire

Now, let's talk about science and research.

Q1. Please tell me what comes to your mind when you think about science and research? (Prompt 'anything else?' after each word or sentence) (Multiple answers possible; list enclosed for interviewer)

Natural sciences	
Engineering and technology	
Medical sciences	
Agricultural sciences	
Social sciences	
Humanities	
Biotechnology (If specifically mentioned)	
Information technology (If specifically mentioned)	
Don't know	

Other (To be recoded)_____

Q2. Are you very, somewhat, slightly or not at all interested in science and research (Borre 1989, AFSK)

Very interested	
Somewhat interested	
Slightly interested	
Not at all interested	
Don't know	

Q3. I am going to read out a list of areas in which new technologies are currently developing. For each of these areas, 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? (EB46.1, EB52.1)

	Will improve	Will have no effect	Will make things worse	Don't know
Solar energy				
Information technology				
Biotechnology (split ballot A)				
Genetic engineering (split ballot B)				
New materials or substances				
Space exploration				
Nuclear energy				

Q4. People can have different opinions about what is scientific and what is not. I am going to read out a list of subjects. For each one tell me how scientific you think it is by the scale on this card. Number 5 means that you think it is 'very scientific' and number 1 that it is 'not at all scientific'. The other numbers mean somewhere in between. Tell me for each subject the number you think best describes how scientific the subject is. If you have never heard of the subject don't hesitate to say so. (Show card). (EB38.1, AFSK, NSF)

	1	2	3	4	5	Never heard of	Don't know
a. Biology							
b. Astronomy							
c. History							
d. Physics							
e. Astrology							
f. Economics							
g. Medicine							
h. Psychology							
i. Social science							
j. Modern biotechnology							
k. Information technology							

Q5. If you should asset your own knowledge of science and research, would you say that you know more, the same as or less than most people about science and research? (Borre 1989, AFSK)

More than most people	
The same as most people	
Less than most people	
Don't know	

Q6. In your opinion, is society spending too little, too much or a sufficient amount of money on science and research? (AFSK)

Too little (go to Q6_1)	
Too much (go to Q6_1)	
Sufficient	
Don't know	

Q6_1. Were you thinking of any particular field of science and research? (AFSK) (Multiple answers possible; list enclosed for interviewer)

Natural sciences	
Engineering and technology	
Medical sciences	
Agricultural sciences	
Social sciences	
Humanities	
Biotechnology (If specifically mentioned)	
Information technology (If specifically mentioned)	
No particular field	
Don't know	

Other (To be recoded)_____

Q7. With which of the two following statements do you agree the most? (Show card) (NIFU, AFSK)

A. Scientific knowledge provides the best grounds for political decisions.
B. Values and attitudes should matter more than scientific knowledge when making political decisions.

Agree with A the most	
Agree with B the most	
Don't know	

Q8. Please tell me what comes to your mind when you think about modern biotechnology in a broad sense? (Prompt 'anything else?' after each word or sentence) (EB46.1, EB52.1, AFSK)

1. 'Category 1'	
2. 'Category 2'	
3. 'Category 3'	
4. 'Category 4'	
5. 'Category 5'	
6. Other (write in full)_____	
7. Other (write in full)_____	

Q8_1. Do you have a positive, negative or neutral opinion about (Insert Q8 1-7)? (EB52.1)

	Positive	Negative	Neutral	Irrelevant	Don't know
Q8 1					
Q8 2					
Q8 3					
Q8 4					
Q8 5					
Q8 6					
Q8 7					

Q9. Please tell me whether you have heard of this application of biotechnology before, or not? (Read items a-h out separately; tick if answer is 'yes') (EB46.1, EB52.1, USA)

Q9a_1. (Show card X with item a, 4 dimensions and scale. Code 1 if 'definitely agree', code 2 if 'tend to agree', code 3 if 'tend to disagree', code 4 if 'definitely disagree' and code 5 if 'don't know'.) Could you please tell me whether you definitely agree, tend to agree, tend to disagree or definitely disagree that this application is useful for society?

Q9a_2. And to what extent do you agree that this application is a risk for society?

Q9a_3. And to what extent do you agree that this application is morally acceptable?

Q9a_4. And to what extent do you agree that this application should be encouraged?

(Proceed with items b-h.)

	Heard of	Useful	A risk	Morally accept-able	Should be encour-aged
a. Using modern biotechnology in the production of foods, for example to make them higher in protein, keep longer or change the taste.					
b. Taking genes from plant species and transferring them into crop plants, to make them more resistant to insect pests.					
c. Introducing human genes into bacteria to produce medicines or vaccines, for example to produce insulin for diabetics.					
d. Cloning human cells or tissues to replace a patient's diseased cells that are not functioning properly.					
e. Cloning animals such as sheep to get milk which can be used to make medicines and vaccines.					
f. Using genetic testing to detect diseases we might have inherited from our parents such as cystic fibrosis, mucoviscidosis or thalassaemia.					
g. Developing genetically modified bacteria to clean up slicks of oil or dangerous chemicals.					
h. Using DNA-testing in fighting crime.					

Q10. Many people engage in the debate about modern biotechnology. How much confidence do you have in the people and organizations I mention now - much confidence, some confidence, not much confidence or no confidence at all? (Read out a-h) (Borre 1989, AFSK)

	Much confidence	Some confidence	Not much confidence	No confidence at all	Don't know
a. Scientists in biotechnology					
b. Environmental organizations					
c. Politicians					
d. Journalists					
e. Religious spokesmen					
f. Private companies in the biotechnology sector					
g. International institutions (not companies)					
h. Consumer organizations					

Q11. For each of the following statements, please tell me whether you think it is true or false. (EB46.1, 52.1, Miller)

	True	False	Don't know
a. There are bacteria which live from waste water			
b. Ordinary tomatoes do not contain genes, while genetically modified tomatoes do			
c. The cloning of living things produces genetically identical offspring			
d. By eating a genetically modified fruit, a person's genes could also become modified			
e. It is the father’s genes that determine whether a child is a girl			
f. Yeast for brewing beer consists of living organisms			
g. It is possible to find out in the first few months of pregnancy whether a child will have Down's Syndrome.			
h. Genetically modified animals are always bigger than ordinary ones			
i. More than half of human genes are identical to those of chimpanzees			
j. It is impossible to transfer animal genes into plants			

Q12. People have different opinions about modern biotechnology. I am going to read you a number of statements. For each on please tell me whether you definitely agree, tend to agree, tend to disagree or definitely disagree. (Read out a-m) (EB46.1, AFSK, Borre 1989)

	Definit. agree	Tend to agree	Tend to disagree	Definit. disagree	Don't know
a. It is important not to lag behind when it comes down to utilizing the opportunities of modern biotechnology.					
b. It is morally wrong to change the hereditary characteristics of animals and human beings.					
c. The risk of dangerous bacteria spreading to the natural environment during biotechnological experiments is highly overstated.					
d. An international ban should be placed on any kind of genetic engineering.					
e. If a firm in my neighborhood started using biotechnology in its production, I would protest.					
f. Current regulations are sufficient to protect people from any risks linked to modern biotechnology.					
g. Irrespective of the regulations, biotechnologists will do whatever they like.					
h. Only traditional breeding methods should be used, rather than changing the hereditary characteristics of plants and animals through modern biotechnology.					
i. The regulation of modern biotechnology should be left mainly to industry.					
j. Modern biotechnology is so complex that public consultation about it is a waste of time.					
k. I would buy genetically modified fruits if they tasted better.					
l. Religious organizations need to have their say in how modern biotechnology is regulated.					

Q13. Some persons have argued that modern biotechnology will create major benefits for society, while other persons have argued that modern biotechnology constitutes serious risks for society. In your opinion, are the risks substantially or slightly greater than the benefits, are the benefits substantially or slightly greater than the risks, or do the benefits equal the risks? (Show card) (NSF)

Risks substantially greater than benefits	
Risks slightly greater than benefits	
Benefits equal risks	
Benefits slightly greater than risks	
Benefits substantially greater than risks	
Don't know	

Additional questions.

Sex, age, education, research experience, income, religious affiliation, rural/urban area etc.

Q101. How often do you watch the news on TV? (AFSK)

Every day	
Almost every day	
At least once a week	
Less than once a week	
Never	
Don't know	

Q102. How often do you read newspapers? (AFSK, NSF)

Every day	
Almost every day	
At least once a week	
Less than once a week	
Never	
Don't know	

Q103. Let us talk now about those issues in the news which interest you. For each issue I read out, please tell me if you are very interested, moderately interested or not at all interested in it. (EB38.1, AFSK, NSF)

	Very interested	Moderately interested	Not at all interested	Don't know
a. Sports news				
b. Politics				
c. New medical discoveries				
d. Environmental pollution				
e. New inventions and technology				
f. New scientific discoveries				
g. Modern biotechnology				
h. Information technology				
i. Agricultural and farm issues				
j. Millitary and defense policy				