QPCRGMOFOOD Work Package 6:
Socio-economic impact of GMO regulation and GMO detection

Final Report
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Executive summary

It is public attitudes and consumer responses that will determine the long-term role of biotechnology in our society. It is therefore important to examine public attitudes and responses towards genetic modification applied to food and agriculture, and to understand the basis of consumer concerns where these exist.

The current situation

- At the present time, there no genetically modified (GM) whole foods on the market in any of the three countries included in the empirical work reported (Italy, Norway and the UK). This is not the case for *genetically modified ingredients,* which are found in all European countries.
- Important determinants of consumer confidence regarding genetically modified food include consumer choice, control by science and trust in risk regulators and the food industry. An *effective labelling strategy* for foods containing genetically modified ingredients is not possible unless *accurate traceability mechanisms* are developed to identify where such ingredients actually are in the food chain.
- Public distrust in genetically modified foods is, in part, driven *by lack of personal control* over exposure to products, together with reduced opportunities for consumer choice over consumption. *Scientific and regulatory inability* to trace genetically modified foods from field to table will act to reduce public confidence in food security.
- From this, it is reasonable to assume that increased *traceability* of genetically modified ingredients will have a positive effect on consumer confidence, assuming such a traceability strategy is linked to an *effective food labelling policy*. Providing information about improved traceability methods may increase consumer confidence in genetically modified foods.
- The aim of empirical work is to investigate the impact of *information about traceability and detection methods on consumer attitudes towards genetically modified food and consumer trust* in Italy, Norway and the UK.
- Four hundred and two Italians, 315 Norwegians and 416 English participants took part in the study. Quota sampling was used to ensure representative samples in each EU member state. At the start of the study, *all* participants were asked about their preferences for labelling strategies. The samples were split between the two information conditions, with half in each condition. Participants in the *experimental information* condition received a page of information about traceability of GM material, and new detection methods. Participants in the *no information* condition did not receive this information.
- A questionnaire (previously piloted in the UK) was developed. This was designed to examine people's attitudes towards genetically modified foods and ingredients, trust in science, regulators and the food industry, and people's preferences for different strategies regarding the labelling of genetically modified products. The results were analysed using

a range of multivariate and descriptive analyses, with emphasis placed on differences in *participant attitudes in the information and no information conditions,* and between *different EU member states*.

KEY RESULTS

Attitudes to labelling of GM food

- About 40% of people claimed that they would not buy, and 40% would possibly buy GM food. There were few differences between the three countries, implying that some of the cross-cultural differences observed in previous research were disappearing with time.
- People believed that *labels should state if food or ingredients have been genetically modified, that processed food derived from GM crops should be labelled,* and that GM and non-GM crops should be *kept separate at all stages of processing.* In particular, people thought that even foods containing GM ingredients through accidental contamination during processing should be labelled, implying that effective traceability would be tacitly approved by consumers as a prerequisite of such labelling strategy. The vast majority of consumers claimed to currently *check food labels for information about genetic modification* in Italy and Norway. Over 60% of the English sample were aware that the UK supermarkets had removed GM ingredients from their own brand products, and they claimed they would check food labels more frequently if this was not the case.
- The *Norwegians were most trusting of scientists and their own government,* and the *Italians were most trusting of the European Commission*. The English were least trusting of all three information sources.
- Contrary to the hypothesis, *there was no effect of receiving information about traceability or detection methods on attitudes* about risk, benefit, perceived control and trust. One exception was observed. People in England receiving the information about traceability were more likely to believe that genetic modification would benefit consumers in the future than those who did not receive the information.

Improving perceived control and confidence in safety of GM food

- People in all three countries wanted *"clearer labelling of GM foods on food packaging".* The English, in particular, wanted an *effective system of traceability* throughout the food chain. People *approved of enforcing ingredient traceability* once they were made aware of its potential.

Genetic modification and the media

- Fewer people in Italy had noticed reports about genetically modified foods in the media than in Norway and England. Only half of the sample believed that media reports about genetic modification of food were informative. *Media reports were characterised as alarming, sensationalised, and tending to present conflict and disagreement.*

POLICY IMPLICATIONS

Consumer response to the development of an effective system of traceability for GM food and ingredients throughout the food chain was generally very positive, although it did not specifically influence people's attitudes towards genetically modified foods. However, failure to implement an effective traceability strategy for genetically modified foods and ingredients may have a negative long-term impact on consumer confidence in food security, particularly in the current climate of consumer distrust in food safety, science and risk regulation.

1. As traceability mechanisms are developed, this information should be placed in the public domain. Similarly, incidents of cross-contamination between GM and non-GM ingredients should be reported to the public as soon as they occur.

Failing to develop an effective labelling strategy, which takes due account of accidental contamination, would eliminate consumer choice and result in more consumer negativity towards genetically modified products. People want food and ingredients to be *labelled irrespective of the amount of GM material contained*.

2. It is recommended that a labelling strategy be developed and implemented as soon as technically feasible.
3. Research may be needed to determine the most effective form for food labels, which take due account of cross-cultural differences in information preferences if these exist.
4. There was a clear preference for labelling of products on the basis of both process and product characteristics. This mitigates against the *utilisation of substantial equivalence* as a basis for labelling practices.
5. The lack of differentiation between the different European member states implies that the development of labelling policy will be most effective at a European level, as opposed the development of individual labelling policies in each European member state separately. In the case of Norway, it may be useful to develop a national policy harmonised with the European Community model.
6. Such a labelling policy needs to be developed in conjunction with more effective information dissemination practices.
7. An open and transparent system of labelling regarding GM foods and ingredients, coupled with effective traceability mechanisms, will provide the best basis for consumer choice regarding the consumption of GM foods. Information provided by the media is likely to be regarded as sensationalist and unduly negative in the long-term.
8. Future research might usefully focus on why such profound cross-cultural differences in trust in different institutions and information sources exist. This information might be used to understand the best way to instigate institutional reform and structure in order to regain consumer confidence in food security (for example, in the case of the developing European Food Agency, and more widely as part of the emerging "science and society" agenda).

1. Introduction

The successful commercialisation of genetically modified foods depends on consumer acceptance of the technology and its applications. By implication, therefore, it is public attitudes and consumer responses that will determine the long-term role of biotechnology in our society (Frewer and Shepherd, 1998). Thus, it is important to examine public attitudes and responses towards genetic modification applied to food and agriculture, and to understand the basis of consumer concerns where these exist.

At the time of writing this report there are no genetically modified (GM) whole foods on the market in any of the three countries included in the empirical work reported (Italy, Norway and the UK). This is not the case for genetically modified ingredients, which are found in all European countries. For example, GM material is widely used in the production of vegetarian cheese (as an enzyme used to replace calf rennet). In addition, GM ingredients are used in processed food. GM soya (and maize, used in animal feed) has been imported into Europe since late 1996. About two thirds of manufactured food products contain derivatives of, or ingredients made from, soya. GM soya was introduced into most of the European food supply under conditions where traceability mechanisms had not been put into place, and so consumer choice over whether to consume genetically modified ingredients was not possible. The GM soya was mixed with non-genetically modified soya after harvesting and subsequently used as an ingredient. Furthermore, no efficacious labelling policy regarding GM ingredients had been introduced at this time. It was hypothesised by contemporary observers that this lack of concern acted as a trigger for public negativity towards genetically modified foods observed soon after (Lassen, Madsen and Sandøe, 2002). The controversy can be interpreted as an expression of the inability of the policy measures set up in the 1980s to meet the concerns of the public. Public concerns were more complex and went beyond the risks to environment and health addressed by the existing regulation. One interpretation of public negativity is that public authorities and companies, when constructing a regulatory framework, in which to contain the developing technology, failed to take due account of what in reality was driving public concern and risk perceptions. The public debate was less about risk, and more focused on issues of traceability, labelling and consumer choice. Subsequent to these events, genetic modification of food was been associated with a great deal of media attention across Europe, in particular in the UK (Frewer, Miles and Marsh, in press).

Research conduced in Europe in the early 1990s indicated that consumer knowledge about genetic modification was low. None-the-less, consumers were able to provide opinions about genetic modification, which were not all uniquely related to risk (Sparks, Shepherd and Frewer,1994; Sparks and Shepherd, 1994; Scholten, Feenstra and Hamstra, 1991; Zimmerman, Kendall, Stone and Hoban, 1994).

More recent research has indicated that genetic modification is still a concern, and people perceive it to be associated with health risks for themselves, and risks to future generations and the environment (Miles and Frewer, 2001; Hunt and Frewer, 2001; Saba, Rosati and Vassallo, 2000; Rosati and Saba, 2000; Saba and Vassallo, 2002). Even with a high level of knowledge about the technology, people still believe that biotechnology should be subject to more control and they demand more studies aimed at assessing safety (Eurobarometer, 2001).

Eurobarometer surveys on public perception of biotechnology also indicate that public perception of genetically modified food is generally negative (Gaskell, Bauer and Durant, 1998; Gaskell, *et al*, 2000). By 1999, fewer people than before believed that biotechnology would improve their way of life. Attitudes to genetically modified food were characterised by doubts about the adequacy of current biotechnology regulations, a belief that industry should not be self-regulating, a desire for genetically modified foods to be labelled, and for the development of an effective public consultation strategy regarding the development and implementation of biotechnology. The issue of perceived need is also important; whilst consumers appear to see clear benefits to medical applications, some consumers question whether genetic modification of food is actually needed (Scholten, Feenstra and Hamstra, 1991; Sparks, Shepherd and Frewer, 1994; Frewer, Howard and Shepherd, 1997).

Data from the 2001 Eurobarometer survey indicates that, at the time of writing, in general people do not appear to want genetically modified food, and they disagree with industry and the scientific community that it does not present any particular danger (Eurobarometer, 2001). People display a strong desire for having the right to choose. In addition, people want information about GM food before eating it, and they want scientific proof that GM food is harmless before it may be eaten. However, some of the people surveyed did believe that the dangers associated with GM foods had been exaggerated by the media; this was particularly the case for the Danes, the British and Greeks.

The Eurobarometer survey research indicated the presence of some cross cultural differences in people's attitudes towards genetically modified food. All the countries had become more negative towards genetically modified foods between the 1996 and 1999 surveys, although differential increases were observed in some countries relative to others (Gaskell, *et al*, 2000; Eurobarometer, 2001).

1.1. Differences in attitudes between different EU member states

There is an enormous amount of literature focusing on cross-cultural differences in consumer opinion regarding genetically modified foods. It is not our intention to review this research here. Suffice it to say, however, that cross-national differences have been observed associated with qualitative, as well as quantitative differences in perceptions and concerns.

For example, in one study, public perception of GM yoghurt and beer was investigated in Denmark, Italy, Germany and the UK. The genetically modified yoghurt was generally perceived to be artificial, unwholesome, unfamiliar and less healthy. It was also seen to be unnecessary in all the assessed countries but Italy. Consumers in Denmark and Germany saw genetic modification as morally wrong, and harmful to nature. The benefits ascribed to the genetically modified product by the researchers, being low in fat and containing no additives, were appreciated for health reasons by consumers. The findings for the genetically modified beer were very similar with the product being associated with unnaturalness, unwholesomeness and low trust. It was perceived to be unfamiliar and morally wrong in all the countries except Italy. Consumers in Germany and Denmark perceived it to be unnecessary. The benefit ascribed to the product by the researchers, being environmentally friendly, was appreciated by consumers in Denmark, Italy and the UK, but not in Germany. Generally the German consumers did not believe the product benefited anyone but the producers (Scholderer, Balderjahn, Bredahl and Grunert, 1999).

In another study investigating public perception of GM food in the UK and Italy, it was found that consumer concerns were very similar in both countries. Ethical concerns and worries about tampering with nature were important in both countries. However, only the UK participants' worries were related to potential risks of the technology (Saba, Moles and Frewer, 1998). Later work has confirmed that perception of risks is far less important that perception of benefits in determining attitudes to genetic modification in Italy (Saba, Rosati and Vassallo, 2000). It is important to take cross-cultural differences in attitudes into account, particular across different EU member states.

1.2. Why is traceability important?

Perceived control over genetic modification is commonly seen to be higher for science, society and the government than personally and for other people (Frewer and Shepherd, 1995, Miles and Frewer, in press). Fife-Schaw and Rowe (1996) found that genetically modified foods were perceived to be uncommon and something that few people eat. Furthermore, participants believed that it was not easy to tell if genetically modified food posed a health risk. They also perceived scientific knowledge of the risks associated with genetically modified foods to be low and regulations were judged to be inadequate.

Linked to this perception of low personal control is a desire for more information about the use of biotechnology and a desire for the ability to make informed choices. Zimmerman, Kendall, Stone and Hoban (1994) found that consumers tended to agree that the average citizen has too little say in decisions about biotechnology. Whilst people believed that the government should be involved in ensuring the safety of foods developed using biotechnology, they questioned the government's ability to do so, and some participants felt that the ultimate control over the safety of foods should be with the consumer (through their purchase

choices). This desire to be able to choose was an important theme to emerge from both of two consensus conferences held in the UK (including the first UK National Consensus Conference on Plant Biotechnology held in London in 1994) The conclusions emphasised the importance of an internationally consistent system of labelling to ensure that consumers could make fully informed choices (Ellahi, 1995; Reynolds, 1997).

1.3. Trust in information sources and actors engaged in GM foods

There is much debate about the need to increase public confidence in regulation and risk management, particularly in the context of the potentially negative environmental impact of established and emerging technologies. Regulatory institutions often attribute low levels of public confidence to distrust in both risk management practices and the motives of science and regulators. For example,

> In the case of GM foods, indeed any food, attitudes are not only dependent on an analytical assessment of risk and benefit. Other factors, such as ethical and moral considerations, knowledge of the technology and trust in the regulatory system play a part (Select Committee on Science and Technology, 1999: para 21).

Approaches to improving public confidence in risk management processes have included reassessing the way in which risks are managed by regulatory institutions and bodies. Such attempts may focus on increased transparency in regulatory practice (for example, increased tendencies to hold meetings of scientific advisory committee meetings in public, or traceability of genetically modified ingredients through the food chain).

Trust in industry, government and regulators has been identified as an important factor in determining people's perception of risk and acceptability of hazards (e.g. Bord and O'Connor, 1992; Slovic, 1993; Johnson and Slovic, 1995; Siegrist, Cvetkovich and Roth, 2000). Public reactions to risk communication can be influenced by factors in addition to the content of the information itself, such as trust in the source of the information (Frewer, Howard, Hedderley and Shepherd, 1996; Cvetkovich and Löfstedt, 1999). Work has been conducted to understand the causes of, or associated psychological constructs that result in, trust (and distrust) in different information sources (Frewer, Howard, Hedderley and Shepherd, 1996). The validated methodology developed by these authors can be used to examine how different information sources are perceived with regard to trust and distrust characteristics.

If public distrust in genetically modified foods is driven by lack of personal control over exposure to products and lack of consumer choice, then it is reasonable to assume that increased traceability of genetically modified ingredients will have a positive effect on consumer confidence, assuming such a traceability strategy is linked to an effective food labelling policy. Providing information about improved scientific traceability methods, it is

hypothesised, will increase consumer confidence in genetically modified foods, particularly if harnessed to an effective labelling policy.

1.4. Aims of the current study

The aim of this study is to investigate the impact of information about traceability and detection methods on attitudes toward genetically modified food, and trust in regulators in Italy, Norway and the UK.

It is hypothesised that information about improved traceability will increase perceptions of trust in regulators' ability to inform the public about GM, develop and effective labelling strategy, and it will improve perception of choice. This will result in more positive attitudes towards GM foods.

Policy recommendations will be detailed concerning the development of communication about traceability in the three countries.

Pilot study

2. Introduction

A pilot study was conducted in England. This was to ensure that there were no problems with the way the questionnaire was laid out or question wording. Participants were invited to comment on any aspect of the questionnaire with the following instructions: "This questionnaire will be sent to 400 people in each of three European countries as part of a study investigating public attitudes to genetic modification of food. You have been asked to participate as part of the pilot study. We would appreciate it if you could complete the questionnaire and then write any comments you may have, for example, about the layout or the wording of specific questions at the end. For example, there may be some questions that were unclear to you, or response labels that could be phrased better, or there may be other issues you think should be included. Any comments you provide will be appreciated." The participants comments were examined for problems experienced by the participants when responding to the questionnaire items, and information about how the questionnaire might be improved.

Whilst some preliminary analysis was conducted, the main purpose of the analysis was to examine the questionnaire items for any that all the participants were answering in an extreme, or that more than 10% of the sample had declined to complete.

2. Method

2.1. Participants

Sixty participants took part in the pilot study. There were 17 male and 43 female participants (mean age = 52.31, SD ± 13.20). They had been in full time education for an average of 7.59 years (SD ± 2.78) after age 11.

2.2. Design and conditions

A between subjects design was used, where each participants was randomly allocated to either the experimental *information* condition, or the control *no information* condition.

2.3. Materials

A questionnaire was designed to investigate public attitudes toward genetic modification (GM) of food and trust in information sources (see Appendix 1). Section 1 contained items designed to investigate attitudes toward labelling. For participants in the experimental *information* condition Section 1 was followed with a page of information about traceability of GM material, and new detection methods. Participants in the control *no information* condition went straight to Section 2.

Section 2 assessed perception of risk and benefit associated with genetically modified food. In addition, items were included to investigate trust in scientists, UK regulators and the European Commission (EC) to protect the public, and preference for measures that could be taken to increase perceived control over exposure to GM food, and confidence that GM products were safe.

Section 3 assessed attitudes to GM by requiring participants to indicate the extent to which they agreed with thirty five statements. Thirty three of these statements were taken from Miles and Frewer (2001). These statements included both general issues related to perceived risk (e.g. necessity of the technology, control of the technology) and issues raised by participants in interviews about genetic modification of food (e.g. GM leading to cheaper food, adverse effects on the environment), as identified in the psychometric work conducted by Slovic and his colleagues (e.g. Slovic, Fischhoff and Lichtenstein, 1980). An additional three statements referring to potential benefits of genetic modification were included to address an imbalance of 'risk' to 'benefit' statements ("Genetic modification will lead to less pesticide/herbicide use", "Genetic modification of food will benefit the consumers' health", "Genetically modified foods will have an improved flavour").

Section 4 assessed perception of nineteen characteristics of information sources associated with trust and distrust, as identified by Frewer, Howard, Hedderley and Shepherd (1996), for five information sources: The food industry, A consumer organisation, The UK Government, The European Commission, and Scientists involved in developing the technology. Finally, demographic data were collected in Section 5.

2.4. Procedure

One hundred questionnaires were sent to volunteers living in Reading, UK held on a participant database. All of the participants had been involved in previous empirical research conducted at the Institute of Food Research. Sixty questionnaires were returned. The participants were paid £5.00 upon returning the completed questionnaire. The study took place in June 2001.

3. Results

3.1 Participant comments

One third of the sample (n = 20) provided comments. Two of the participants used this as an opportunity to comment generally on their concerns about genetic modification. A further two participants merely noted their appreciation of the layout and question format. With regard to specific comments about the questionnaire layout or item wording, some participants suggested that items asking about the media should be included. In addition, some participants wanted an 'I'don't know' option for the Section 3 items. Other participants expressed a desire for a third option for some of the items where a Yes / No option was

provided. These suggestions were incorporated into the design of the final version of the questionnaire.

3.2. Section 1 - Labelling of genetically modified food

It was found that 98% of the sample claimed to have heard of genetic modification, or genetically modified food (Table 1).

Forty one percent of the sample said that they would purchase genetically modified food if it became widely available in the supermarkets, although some of the participants expressed a desire for a 'possibly' option for this item (Table 1).

Virtually all of the participants (95%) believed that labels on food packaging should state if the food or any of its ingredients have been genetically modified. In addition, 80% of the sample believed that processed food ingredients from a GM crop should be labelled. However, only 42% of the sample claimed to currently check food labels for this information (Table 1). This may be due to their knowledge of the UK supermarket's removing genetically modified ingredients from their own label products, and using GM free sources where possible. Since 1998 most of the major UK supermarkets have eliminated genetically modified ingredients from their own brand products in response to consumer concern (Jones, Clarke-Hilll, Hillier and Shears, 2000). The supermarkets also set up telephone helplines, started a policy of voluntary labelling, and began working to remove genetically modified products from animal feed. This warrants further consideration and items to investigate this will be included in the final questionnaire.

Ninety percent of the sample thought that GM and non-GM crops should be kept separate at all stages so that food labels can be accurately labelled as to whether they contain ingredients from non-GM crops (Table 1).

When provided with information about the current regulations regarding labelling 73% of the participants believed that the current regulations were not strict enough, and that ingredients should be labelled if they contain any GM material at all. In contrast, 22% believed that the current regulations were fine, and only 5% believed that the regulations were too strict (Figure 2).

Table 1. Labelling preferences

	Yes	*No*
Have you heard of genetic modification, or genetically modified foods?	98%	2%
Would you purchase GM food if it became widely available in the supermarkets?	41%	59%
Do you think labels should state if food/ingredients have been genetically modified?	95%	5%
Do you currently check labels to see if food/ingredients have been genetically modified?	42%	58%
Should ingredients from GM crops, that have been processed, be labelled?	80%	20%
Should GM and non- GM crops should be kept separate to enable accurate labelling?	90%	10%

Table 2. Perception of benefits and harmful health effects

	Benefits to consumers		χ^2 *(df)*	*Harmful health effects*		χ^2 *(df)*
	Yes	*No*		*Yes*	*No*	
Both conditions combined	23 (39%)	36 (61%)	2.864 (1)	37 (64%)	21 (36%)	4.414 (1)*
Information	12 (50%)	12 (50%)	2.064 (1)	16 (66.7%)	8 (33.3%)	0.146 (1)
No information	11 (31.4%)	24 (68.6%)		21 (63.8%)	13 (36.2%)	

*Significant at the * p < .05 level*

Table 3. Perception of benefits, harmful health effects and trust

	Combined	*Information*	*No information*	*F (df)*
Benefits in the future	4.02 (1.77)	4.38 (2.02)	3.78 (1.57)	1.656 (1,58)
Seriousness of harmful health effects	4.47 (1.70)	4.33 (1.58)	4.56 (1.80)	0.242 (1,58)
Likelihood of personally experiencing harmful health effects	5.05 (1.51)	4.96 (1.68)	5.11 (1.41)	0.145 (1,58)
Control of personal exposure to GM food in diet	4.68 (1.40)	4.54 (1.72)	4.78 (1.15)	0.408 (1,58)
Trust in scientists	4.65 (1.53)	4.63 (1.84)	4.67 (1.31)	0.011 (1,58)
Trust in UK regulators	5.07 (1.55)	4.83 (1.71)	5.22 (1.44)	0.905 (1,58)
Trust in the European Commission	5.48 (1.40)	5.63 (1.71)	5.39 (1.15)	0.408 (1,58)

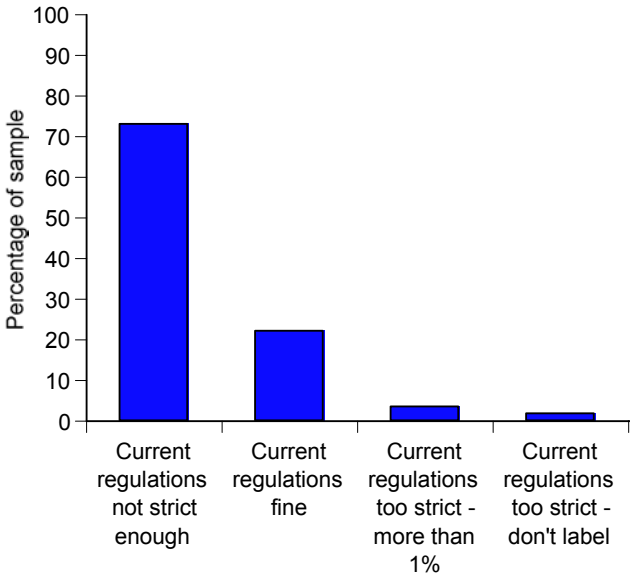

Figure 2. Participant's opinion about the current regulations regarding labelling

3.3. Section 2 - Perceived risk, benefits, control and trust

It was found that the majority of the participants believed that consuming genetically modified food would cause harmful health effects. It was also found that most of the participants believed that there were currently no benefits to genetic modification of food, but this difference was not significant (Table 2). Some of the pilot study participants expressed a preference for a 'I don't know' option for these two items.

Examination of the means in Table 3 indicate that it was judged to be moderately likely that there would be benefits to consumer from genetic modification in the future. Trust in the three information sources was relatively low, particularly trust in the UK regulators and the European Commission. Perception of personal control over exposure tended to be low. The harmful health effects were perceived to be tended to be moderately to slightly serious. Perceived personal likelihood of experiencing any harmful health effects was low. No measure of likelihood for other people was taken, this will be remedied in the final questionnaire.

Further analysis was conducted to investigate relative perception of trust in the three information sources (Table 4). Analysis, using a repeated measures ANOVA, indicated that scientists were significantly more trusted than the UK regulators of the European Commission (Huynh-Feldt: $F(1.457,85.984) = 10.144$, $p < .001$).

Table 4. Mean (and standard deviation) ratings of trust

Information source	*Mean (SD)*
Scientists	4.65 (1.53)[ab]
UK regulators of GM food	5.07 (1.55)[a]
European Commission	5.48 (1.40)[b]

Means with the same letter by them are significantly different at the p = .05 level (LSD)

More people expressed a preference for more information about any associated risks in order to increase perceptions of personal control. Other popular options were: an effective system of traceability, more information about how food and ingredients are genetically modified and clearer labelling of genetically modified foods on food packaging. Better detection methods and information about what the UK risk regulators are doing to ensure their food is safe (Table 5).

More people expressed a preference for more information about any associated risks in order to enable them to feel more confident that genetically modified food product in the shops are safe. This was closely followed by more information about how food and ingredients are genetically modified; both options preferred by over 70% of the sample. As with options to increase perceived control, other popular options were: an effective system of traceability, more information about what the UK risk regulators are doing to ensure the public's food is safe, and clearer labelling of genetically modified foods on food packaging. Additionally, participants wanted more information about the benefits to consumers and information about how the European Commission was ensuring the public's food was safe (Table 6).

3.3.1. Comparing the two conditions

Participants in the experimental *information* condition read the information about traceability and detection methods between Sections 1 and 2. Analysis was conducted to investigate if there were any differences between the two conditions in perception of benefits, harmful health effects, control and trust in scientists, UK regulators and the European Commission to protect the public. It should be noted at this stage that the participant numbers in the two conditions are relatively low (*no information* = 36, *information* = 24). When interpreting analysis conducted to compare the two conditions this should be borne in mind.

There was no differences between the two conditions in perception of benefits, control, harmful health effects, or trust (Tables 2 and 3).

Table 5. Options preferred by participants to make them feel in control of their exposure to GM food / ingredients

Statement options for feeling in control of exposure to GM food / ingredients	*Combined (n = 60)*	*Information (n = 24)*	*No information (n = 36)*
More information about how food/ingredients are genetically modified	32 (53.33%)	9 (37.5%)	23 (63.89%)
More information about the benefits to consumers from genetic modification of food	20 (33.33%)	9 (37.5%)	11 (30.56%)
More information about any risks associated with genetic modification of food	48 (80%)	18 (75%)	30 (83.33%)
More information about what the UK risk regulators are doing to make sure your food is safe	24 (40%)	9 (37.5%)	15 (41.67%)
More information about how the European Commission is ensuring your food is safe	19 (13.67%)	11 (45.83%)	8 (22.22%)
An effective system of traceability throughout the food chain	35 (58.33%)	16 (66.67%)	19 (52.78%)
Better methods to detect whether food products contain GM ingredients	24 (40%)	8 (33.33%)	16 (44.44%)
Labelling of all food products containing ingredients produced using GM technology, even if no GM material in final product	17 (28.33)	8 (33.33%)	9 (25%)
Labelling of all GM foods, even if they are similar to those produced by conventional means	16 (26.27%)	6 (25%)	10 (27.78%)
Clearer labelling of GM foods on food packaging	30 (50%)	11 (45.83%)	19 (52.78%)
Clearer labelling of GM foods in restaurants on menus	19 (31.67%)	8 (33.33%)	11 (30.56%)

Table 6. Options preferred by participants to make them feel more confident that GM food products in shops are safe

Statement options for feeling in more confident that GM food products in shops are safe	*Combined (n = 60)*	*Information (n = 24)*	*No information (n = 36)*
More information about how food/ingredients are genetically modified	44 (73.33%)	19 (79.17%)	25 (69.44%)
More information about the benefits to consumers from genetic modification of food	30 (50%)	13 (54.17%)	17 (47.22%)
More information about any risks associated with genetic modification of food	46 (76.67%)	18 (75%)	28 (77.78%)
More information about what the UK risk regulators are doing to make sure your food is safe	33 (55%)	14 (58.33%)	19 (52.78%)
More information about how the European Commission is ensuring your food is safe	25 (41.67%)	14 (58.33%)	11 (30.56%)
An effective system of traceability throughout the food chain	28 (46.67%)	10 (14.67%)	18 (50%)
Better methods to detect whether food products contain GM ingredients	21 (35%)	8 (33.33%)	13 (36.11%)
Labelling of all food products containing ingredients produced using GM technology, even if no GM material in final product	10 (16.67)	2 (8.33%)	8 (22.22%)
Labelling of all GM foods, even if they are similar to those produced by conventional means	13 (21.67%)	5 (20.83%)	8 (22.22%)
Clearer labelling of GM foods on food packaging	25 (41.67%)	7 (29.17%)	18 (50%)
Clearer labelling of GM foods in restaurants on menus	9 (15%)	4 (16.67%)	5 (13.89%)

3.4. Section 3 - Attitudes to genetically modified food

This section consisted of thirty five attitudinal statements, with which participants were required to rate their agreement / disagreement. As pilot study participants requested a 'I don't know' option for these items, this will be included in the final questionnaire. Due to the small sample size, it is not possible to analyse these items as with the final sample (where MANOVA will be used). For the purposes of this report a table of means is included (Table 7). In addition, the data was screened for any items that all the participants were answering with responses to either extreme end of the scale, or that more than 10% of the sample had declined to complete. This was not the case for any of the items.

3.5. Section 4 - Information source characteristics associated with trust and distrust

Nineteen characteristics were rated for five information sources. As with the attitudinal items in Section 3, the sample size is too small and it is not possible to analyse these items as with the final sample (where Principal Components Analysis will be used). Thus, as with the Section 3 items, the data was screened for any items that all the participants were answering in an extreme, or that more than 10% of the sample had declined to complete. This was not the case for any of the items.

Table 7. Mean (and standard deviation) ratings for the attitude statements

Attitude statement	*Mean*	*(SD)*
I personally worry about the use of GM in food production	2.62	(1.69)
The use of GM in food production is an important risk	1.30	(0.56)
Genetically modified foods will last longer	3.60	(1.67)
The use of GM in food production is unethical	3.48	(1.85)
The use of GM in food production is advantageous to the consumer	4.21	(1.86)
The use of GM in food production is advantageous to the farmer	2.76	(1.63)
The use of GM in food production is advantageous to the food industry	1.85	(1.07)
The use of GM in food production is progressive	3.47	(1.83)
The use of GM in food production is controllable by the consumer	5.60	(1.65)
I trust those responsible for regulating the risks of GM in the UK	4.93	(1.99)
I trust those responsible for regulating the risks of GM in other countries	5.73	(1.55)
The use of GM in food production is necessary	5.16	(1.98)
I can choose whether or not to eat food produced using GM	3.86	(2.07)
The use of GM in food production is risky	2.67	(1.62)
GM of food will lead to cheaper food	3.97	(2.06)
The use of GM in food production is avoidable by the consumer	4.80	(1.74)
The real risks of GM in food production are hidden from consumers	2.35	(1.60)
The use of GM in food production makes me wonder what we are eating	1.78	(1.18)
GM of food will lead to less wastage of food	4.32	(1.77)
Genetically modifying food causes problems in the food	3.28	(1.58)
GM of food is interfering with nature	1.95	(1.61)
I don't agree with genetically modifying food	2.80	(1.89)
GM of food will have adverse long term effects on human health	3.18	(1.60)
GM of food will adversely affect future generations	3.07	(1.69)
GM of food will have adverse effects on animals	2.95	(1.53)
GM of food will have adverse effects on the environment	2.67	(1.58)
GM of food will have adverse short term effects on human health	3.08	(1.49)
GM of food adversely affects the food chain	2.72	(1.61)
There are unknown side effects of GM of food	2.03	(1.48)
Public awareness of GM in food should be increased	1.27	(0.66)
BSE and similar food scares increase my concern about GM	2.28	(1.79)
Profit will come before safety with genetically modified foods	1.90	(1.34)
GM will lead to less pesticide/herbicide use	3.58	(1.68)
GM of food will benefit the consumers' health	5.18	(1.48)
Genetically modified foods will have an improved flavour	4.63	(1.48)

NB Please see Appendix 1 for actual statement wording, GM = Genetic modification

4. Discussion

Changes suggested by the pilot study participants were incorporated into the design of the final questionnaire.

Although the pilot study was only conducted in England subsequent data collection in Italy and Norway was not expected to be problematic. Colleagues translating the questionnaire and collecting the data in Italy and Norway were given the opportunity to examine the questionnaire, and no specific problems were identified.

Main Study

5. Method

5.1. Participants

The demographic characteristics of the three samples can be seen in Table 8. The sample size in Italy was 402, with 315 participants in Norway and 416 participants in England. The samples were split between the two information conditions, with half in each condition ($\chi^2(2) = 0.005$, ns). There were no differences between the three countries in terms of participants' gender ($\chi^2(2) = 0.207$, ns), with about 50% male and female in each country. Nor was there a difference between the three countries assessed in age ($F(2,1125) = 0.453$, ns), with the mean age in each country as follows: Italy = 43.40(15.22), Norway = 42.32(14.33), England = 43.03(15.86). Participants in England had been educated for longer than those in the other two countries ($F(2,1050) = 15.376$, $p < .001$): Italy = 5.77(4.28), Norway = 6.21(4.03), England = 7.31(3.45). Fewer participants had children under 18 living at home in the England, and more had children under 18 living at home in Norway ($\chi^2(2) = 85.793$, $p < .001$).

Table 8. Demographic characteristics for the three countries assessed

Demographic characteristics		*Italy*	*Norway*	*England*
Number of participants		416	315	402
Condition	Information	208 (50%)	157 (49.8%)	200 (49.8%)
	No information	208 (50%)	158 (50.2%)	202 (50.2%)
Gender	Male	209 (50.2%)	152 (48.6%)	200 (49.8%)
	Female	207 (49.8%)	161 (51.4%)	202 (50.2%)
Age group *(determined by tertile split)*	18-34 years	135 (32.5%)	96 (30.9%)	134 (33.4%)
	35-49 years	110 (26.4%)	129 (41.5%)	127 (31.7%)
	50+ years	171 (41.1%)	86 (27.7%)	140 (34.9%)
Education after age 11 *(determined by median split)*	0-5 years	196 (53.1%)	144 (48%)	152 (39.6%)
	≤ 6 years	173 (46.9%)	156 (52%)	232 (60.4%)
Children under 18 living at home	No	278 (66.8%)	135 (44.3%)	300 (77.9%)
	Yes	138 (33.2%)	170 (55.7%)	85 (22.1%)
Number of people living in the house	1-2	95 (22.84%)	129 (41.75%)	
	3-4	270 (64.9%)	138 (44.66%)	
	5+	51 (12.26%)	42 (13.59%)	
Social Class	AB			148 (36.8%)
	C1			97 (24.1%)
	C2			45 (11.2%)
	DE			50 (12.4%)
	Unclassified			62 (15.4%)

5.2. Design and conditions

A between subjects design was used, where each participants was randomly allocated to either the experimental *information* condition, or the control *no information* condition. The questionnaire was distributed to different participants residing in three countries: Italy, Norway and England.

5.3. Materials

The questionnaire was designed to investigate public attitudes toward genetic modification (GM) of food and trust in information sources (see Appendices 2-4). It was essentially the same as the pilot study questionnaire (see Appendix 1), with some additional response options as deemed necessary on the basis of the comments provided by the pilot study participants. Section 1 contained items designed to investigate attitudes toward labelling. For participants in the experimental *information* condition, Section 1 was followed with a page of information about traceability of GM material, and new detection methods. Participants in the control *no information* condition went straight to Section 2.

The aim of Section 2 was to assess participants' perception of risk and benefit associated with genetically modified food. In addition, items were included to investigate people's trust in scientists, national regulators and the European Commission (EC), specifically related to protecting the public. People's preference for measures that could be taken to increase perceived control over exposure to GM food, and confidence that GM products were safe were also assessed.

Section 3 assessed attitudes to GM by requiring participants to indicate the extent to which they agreed with thirty four statements. Thirty one of these statements were taken from Miles and Frewer (2001). These statements included both general issues related to perceived risk (e.g. necessity of the technology, worry about the technology) and issues raised by participants in interviews about genetic modification of food (e.g. GM leading to cheaper food, adverse effects on the environment). An additional three statements referring to potential benefits of genetic modification were included to address an imbalance of 'risk' to 'benefit' statements ("Genetic modification will lead to less pesticide/herbicide use", "Genetic modification of food will benefit the consumers' health", "Genetically modified foods will have an improved flavour").

Section 4 assessed perception of nineteen characteristics of information sources associated with trust and distrust, as identified by Frewer, Howard, Hedderley and Shepherd (1996), for five information sources: The food industry, A consumer organisation, The national Government, The European Commission, and Scientists involved in developing the technology. Additional items in Section 4 assessed perception of media reporting about genetic modification of food (these items had not been included in the pilot study) Finally, demographic data were collected in Section 5.

There were some minor differences between the questionnaire distributed in England and the questionnaires distributed in Italy and Norway. It was decided, after discussion with colleagues in Italy and Norway, to qualify some of the attitude items with the phrase 'if

genetically modified food became widely available', due to the limited or lack of availability of GM products in these countries e.g. 'If genetically modified foods became widely available in the supermarkets would you check food labels to see if a food product or any of its ingredients had been genetically modified?'. These items are listed in Appendix 5.

The questionnaire was designed in England, following the pilot work described in Sections 2-4. It was translated into Italian and Norwegian.

5.4. Procedure

In England and Italy participants were recruited by a social research company to ensure quota sampling for gender, age and socio-economic class. The data were collected between July and September 2001. The participants were not paid. In Norway, participants were recruited from an existing participant panel held by MATFORSK, Norway between September and November 2001. The participants were paid NOK 60 (€7.5). No major food scares occurred during the study period in the countries being assessed.

6. Results

6.1 Section 1 - Labelling of genetically modified food (prior to provision of information)

It was found almost all of the sample claimed to have heard of genetic modification, or genetically modified food (Table 9). This was slightly lower in Italy (88%) than in Norway (99%) or England (97%) ($\chi^2(2) = 52.356$, $p < .001$).

Over 40% of the sample in each country said that they would not purchase genetically modified food if it became widely available in the supermarkets, in contrast to 10-15% of the sample said that they would purchase it. Around 40% of the sample said that they would *possibly* buy genetically modified food (Table 9). There were no differences between the three countries in terms of people's stated intention to purchase GM food ($\chi^2(4) = 4.793$, ns).

Virtually all of the participants (92-98%) believed that labels on food packaging should state if the food or any of its ingredients have been genetically modified. This was the same in all three countries ($\chi^2(2) = 2.868$, ns). In addition, between 78-88% of the sample believed that processed food ingredients from a GM crop should be labelled. Slightly fewer participants believed that processed food ingredients from a GM crop should be labelled in Norway in comparison to the other two countries ($\chi^2(2) = 20.343$, $p < .001$). Around 90% of the sample in each of the three countries thought that GM and non-GM crops should be kept separate at all stages so that food can be accurately labelled as to whether it contains ingredients from non-GM crops ($\chi^2(2) = 0.843$, ns). Over 95% of the sample claimed to currently check food labels for this information (either all the time, or sometimes) in Italy and Norway, in contrast to only 62% in England ($\chi^2(4) = 300.772$, $p < .001$). However, 67% of England sample were aware that most UK supermarkets had removed GM ingredients from their own brand products and

66% of the sample claimed that they would check food labels more frequently if this were not the case (Table 9).

When provided with information about regulations regarding stating that ingredients in food that contain less than 1% GM material (through accidental contamination) do not need to be labelled, between 60-81% the participants believed that these regulations were not strict enough, and that ingredients should be labelled if they contain any GM material at all. Significantly fewer people in Norway believed this to be the case, with more people stating that these regulations were fine ($\chi^2(6) = 47.739$, $p < .001$). Only 1 or 2% of the sample in each country believed that there was no need to label when ingredients in food contain less than 1% GM material (through accidental contamination) (Figure 2).

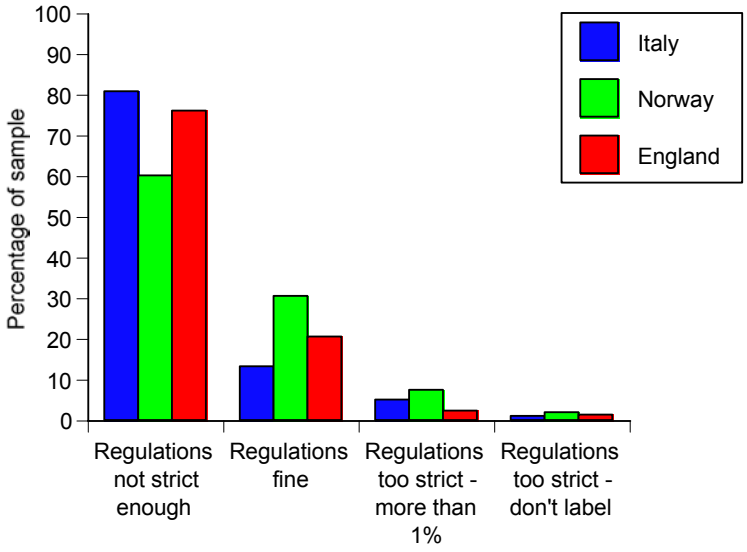

Figure 2. Satisfaction with regulations stating that ingredients in food that contain less than 1% GM material (through accidental contamination) do not need to be labelled.

Table 9. Labelling preferences

	Italy			***Norway***			***England***		
	Yes	*No*	*Possibly/ Sometimes*	*Yes*	*No*	*Possibly/ Sometimes*	*Yes*	*No*	*Possibly/ Sometimes*
Have you heard of genetically modified foods?	365 (87.7%)	51 (12.3%)		309 (99%)	3 (1%)		390 (97.3%)	11 (2.7%)	
Would you purchase GM food if it became widely available?	43 (10.3%)	191 (45.9%)	182 (43.8%)	41 (13.1%)	137 (43.8%)	135 (43.1%)	61 (15.2%)	180 (44.9%)	160 (39.9%)
Should labels state if food/ingredients are GM?	397 (92.4%)	19 (4.6%)		307 (97.8%)	7 (2.2%)		385 (96%)	16 (4%)	
Do you currently check labels to see if food/ingredients are GM?	263 (63.2%)	19 (4.6%)	134 (32.2%)	142 (45.2%)	13 (4.1%)	159 (50.6%)	70 (17.5%)	154 (38.5%)	176 (44%)
Should processed ingredients from GM crops be labelled?	367 (88.2%)	49 (11.8%)		243 (77.6%)	70 (22.4%)		354 (88.3%)	47 (11.7%)	
Should GM and non- GM crops should be kept separate?	382 (91.8%)	34 (8.2%)		282 (90.1%)	31 (9.9%)		362 (90.3%)	39 (9.7%)	
Heard that UK supermarkets have removed GM ingredients?							270 (67.2%)	132 (32.8%)	
Would you check food labels more frequently?							264 (66%)	136 (34%)	

6.2. Comparing participants in the two conditions

Analysis was conducted to compare the participants in the two conditions on a number of demographic characteristics for each of the three countries. It was found that there was no difference in the two conditions in terms of gender, number of years in full time education post age 11, age range or social class (in England); in addition, there was no difference in whether or not the participants had heard of GM (Table 10).

Table 10. Chi square analysis for the two conditions

		Information	*No information*	χ^2 *(df)*
			Italy	
Heard of GM	Yes	181 (87%)	184 (88.5%)	0.201 (1)
	No	27 (13%)	24 (11.5%)	
Gender	Male	107 (51.4%)	102 (49%)	0.240 (1)
	Female	101 (48.6%)	106 (51%)	
Education post age 11	0-5 years	100 (55.2%)	96 (51.1%)	0.648 (1)
	>6 years	81 (44.8%)	92 (48.9%)	
Age range	18-34 years	70 (33.7%)	65 (31.3%)	1.781 (2)
	35.49 years	49 (23.6%)	61 (29.3%)	
	50+ years	89 (42.8%)	82 (39.4%)	
			Norway	
Heard of GM	Yes	154 (99.4%)	155 (98.7%)	0.324 (1)
	No	1 (0.6%)	2 (1.3%)	
Gender	Male	70 (44.9%)	82 (52.2%)	1.696 (1)
	Female	86 (55.1%)	75 (47.8%)	
Education post age 11	0-5 years	70 (47.3%)	74 (48.7%)	0.058 (1)
	>6 years	78 (52.7%)	78 (51.3%)	
Age range	18-34 years	44 (28.4%)	52 (33.3%)	1.043 (2)
	35.49 years	68 (43.9%)	61 (39.1%)	
	50+ years	43 (27.7%)	43 (27.6%)	
			England	
Heard of GM	Yes	196 (98.5%)	194 (96%)	2.261 (1)
	No	3 (1.5%)	8 (4%)	
Gender	Male	100 (50%)	100 (49.5%)	0.01 (1)
	Female	100 (50%)	102 (50.5%)	
Education post age 11	0-5 years	80 (41.5%)	72 (37.7%)	0.566 (1)
	>6 years	113 (58.5%)	119 (62.3%)	
Age range	18-34 years	71 (35.7%)	63 (31.2%)	3.155 (2)
	35.49 years	67 (33.7%)	60 (29.7%)	
	50+ years	61 (30.7%)	79 (39.1%)	
Social class	AB	76 (38%)	72 (35.6%)	2.476 (4)
	C1	42 (21%)	55 (27.2%)	
	C2	25 (12.5%)	20 (9.9%)	
	DE	26 (13%)	24 (11.9%)	
	Unclassified	31 (15.5%)	31 (15.3%)	

6.3. Section 2 - Perceived risk, benefits, control and trust

It was found that the majority of the participants did not know whether or not consuming genetically modified food would cause harmful health effects (52-61%). It was also found that most of the participants did not know whether or not there were currently any benefits to consumers from genetic modification of food (45-51%) (Tables 11 & 12). Receiving information about traceability did not influence attitudes (Tables 11 & 12). Examination of those participants who were able to state whether or not there were any harmful health effects and benefits to consumers from genetically modified foods indicated most participants in each country believed that there were harmful health effects (Italy: $\chi^2(1) = 47.281$, $p < .001$; Norway: $\chi^2(1) = 28.033$, $p < .001$; England: $\chi^2(1) = 19.0$, $p < .001$) and that there were currently no benefits (Italy: $\chi^2(1) = 70.588$, $p < .001$; Norway: $\chi^2(1) = 5.556$, $p > .05$; England: $\chi^2(1) = 10.378$, $p > .001$). As there was no effect of the information condition, the data was collapsed across the two conditions to examine differences between the three countries. It was found that there were no differences between the three countries in terms of whether genetically modified food were seen to cause harmful health effects ($\chi^2(4) = 9.454$, ns). In contrast, for perception of the current benefits from genetically modified foods, fewer of the Italian sample agreed that there were benefits compared to the other two countries ($\chi^2(4) = 24.952$, $p < .001$).

Table 11. Perception of harmful health effects

	Information	*No Information*	*χ^2 (df)*	*Both conditions combined*
		All three countries combined		
Yes	172 (30.7%)	179 (31.8%)		351 (31.2%)
No	64 (11.4%)	75 (69.6%)	1.410 (2)	139 (12.4%)
I don't know	325 (57.9%)	309 (54.9%)		634 (56.4%)
		Italy		
Yes	78 (37.5%)	70 (33.7%)		148 (35.6%)
No	20 (9.6%)	31 (14.6%)	2.846 (2)	51 (12.3%)
I don't know	110 (52.9%)	107 (51.4%)		217 (52.2%)
		Norway		
Yes	43 (27.9%)	46 (29.3%)		89 (28.6%)
No	18 (11.7%)	13 (8.3%)	1.010 (2)	31 (10%)
I don't know	93 (60.4%)	98 (62.4%)		191 (61.4%)
		England		
Yes	51 (25.6%)	63 (31.8%)		114 (28.7%)
No	26 (13.1%)	31 (15.7%)	3.133 (2)	57 (14.4%)
I don't know	122 (61.3%)	104 (52.5%)		226 (56.9%)

Table 12. Perception of benefits

	Information	*No Information*	χ^2 *(df)*	*Both conditions combined*
		All three countries combined		
Yes	100 (17.7%)	95 (16.7%)		195 (17.2%)
No	190 (33.6%)	203 (35.7%)	0.596 (2)	393 (34.7%)
I don't know	275 (48.7%)	270 (47.5%)		545 (48.1%)
		Italy		
Yes	20 (9.6%)	22 (10.6%)		42 (10.1%)
No	78 (37.5%)	84 (40.4%)	0.619 (2)	162 (38.9%)
I don't know	110 (52.9%)	102 (49%)		212 (51%)
		Norway		
Yes	28 (17.8%)	38 (24.1%)		66 (21%)
No	48 (30.6%)	48 (30.4%)	2.041 (2)	96 (30.5%)
I don't know	81 (51.6%)	72 (45.6%)		153 (48.6%)
		England		
Yes	52 (26%)	35 (17.3%)		87 (21.6%)
No	64 (32%)	71 (35.1%)	4.475 (2)	135 (33.6%)
I don't know	84 (42%)	96 (47.5%)		180 (44.8%)

A MANOVA analysis was conducted to investigate the effect of country and information condition on the attitude variables measuring benefits, seriousness of harmful health effects, perceived control and trust (see Appendix 6, Table A for the means). Differences between the three countries were observed ($F(16,1950) = 23.538$, $p < .001$) but receiving the information made no difference overall ($F8,974) = 1.863$, ns). However, a country x condition interaction indicated that this did vary according to country ($F(16,1950) = 2.217$, $p < .01$).

All of the univariate F tests (which measure the effect of the independent variable on each of the dependent variables separately) were significant for country (Appendix 6, Table B). Post hoc analysis, (Tukey HSD, significant at $p = 0.05$) indicated that the Norwegians were most trusting of the scientists and their own regulators, and England participants were least trusting. The Italian sample were most trusting of the European Commission, and the English participants were the least trusting. However, the Norwegians perceived that they had less control over their exposure to GM food than the Italians or the English. The Italian sample were more likely to believe that both they and other people would experience harmful health effects from consuming GM foods than the Norwegians or the English. The Italians also believed that any harmful health effects were more serious than participants in the other two countries. The Italians also believed that it was less likely that there would be benefits to consumers from GM food in the future than the Norwegians.

In general, information provision did not appear to influence attitudes towards GM. However, British participants who received the information paragraph being more likely to believe that there would be benefits to consumers from GM in the future than those who did not receive the information (Appendix 6, Figure A).

6.4. Section 2 - Control over exposure to GM food and confidence that GM food products are safe

The three most popular options to enable people to feel in control of their exposure to genetically modified food and ingredients were common in the three countries. These were: “clearer labelling of GM foods on food packaging”, “more information about how food and ingredients are genetically modified” and “more information about any associated risks” (Table 13). The percentages in Table 14 indicate the same three options were preferred as to enable people to feel more confident that genetically modified food product in the shops are safe. An effective system of traceability throughout the food chain was more popular in England than in the other two countries.

Table 13. Options preferred by participants to make them feel in control of their exposure to GM food / ingredients

Statement options for feeling in control of exposure to GM food / ingredients	*Italy*	*Norway*	*England*
More information about how food/ingredients are genetically modified	264 (63.5%)	162 (51.6%)	233 (58.0%)
An effective system of traceability throughout the food chain	122 (29.3%)	115 (36.6%)	177 (44.0%)
More information about the benefits to consumers from genetic modification of food	156 (37.5%)	103 (32.8%)	127 (31.6%)
Clearer labelling of GM foods on food packaging	244 (58.7%)	230 (73.2%)	243 (60.4%)
Better methods to detect whether food products contain GM ingredients	138 (33.2%)	103 (32.8%)	124 (30.8%)
More information about any risks associated with genetic modification of food	235 (56.5%)	174 (55.4%)	185 (46.0%)
Labelling of all food products containing ingredients produced using GM technology, even if no GM material in final product	166 (39.9%)	92 (29.3%)	116 (28.9%)
Labelling of all GM foods, even if they are similar to those produced by conventional means	136 (32.7%)	136 (43.3%)	147 (36.6%)
More information about what national risk regulators are doing to make sure your food is safe	147 (35.3%)	132 (42.0%)	143 (35.6%)
Clearer labelling of GM foods in restaurants on menus	89 (21.4%)	87 (27.7%)	156 (38.8%)
More information about how the European Commission is ensuring your food is safe	151 (36.3%)	102 (32.5%)	141 (35.1%)

Table 14. Options preferred by participants to make them feel more confident that GM food products in shops are safe

Statement options for feeling in more confident that GM food products in shops are safe	*Italy*	*Norway*	*England*
More information about how food/ingredients are genetically modified	278 (66.8%)	156 (49.8%)	209 (52.0%)
An effective system of traceability throughout the food chain	128(30.8%)	112 (35.8%)	170 (42.3%)
More information about the benefits to consumers from genetic modification of food	168 (40.4%)	97 (31.0%)	128 (31.8%)
Clearer labelling of GM foods on food packaging	201 (48.3%)	230 (73.5%)	194 (48.3%)
Better methods to detect whether food products contain GM ingredients	104 (25.0%)	110 (35.1%)	130 (32.3%)
More information about any risks associated with genetic modification of food	242 (58.2%)	164 (52.4%)	177 (44.0%)
Labelling of all food products containing ingredients produced using GM technology, even if no GM material in final product	157 (37.7%)	80 (25.6%)	95 (23.6%)
Labelling of all GM foods, even if they are similar to those produced by conventional means	117 (28.1%)	112 (35.8%)	139 (34.6%)
More information about what national risk regulators are doing to make sure your food is safe	178 (42.8%)	146 (46.6%)	161 (40.0%)
Clearer labelling of GM foods in restaurants on menus	61 (14.7%)	65 (20.8%)	127 (31.6%)
More information about how the European Commission is ensuring your food is safe	165 (39.7%)	93 (29.8%)	146 (36.3%)

Table 15. Statements where there was a difference between the information conditions

Statement options	*Country*	*Selected*	*Information*	*No information*	χ^2 *(df)*
Feeling confident food is safe: An effective system of traceability throughout the food chain	Italy	Not selected	130 (62.5%)	158 (76%)	8.847 (1) **
		Selected	78 (37.5%)	50 (24%)	
Feeling confident food is safe: An effective system of traceability throughout the food chain	Norway	Not selected	91 (58.3%)	110 (70.1%)	4.686 (1) *
		Selected	65 (41.7%)	47 (29.9%)	
Feeling in control of exposure: An effective system of traceability throughout the food chain	Norway	Not selected	90 (57.7%)	109 (69%)	4.315 (1) *
		Selected	66 (42.3%)	49 (31%)	
Feeling confident food is safe: Labelling of all GM foods, even if they are similar to those produced by conventional means	Italy	Not selected	137 (65.9%)	162 (77.9%)	7.432 (1) **
		Selected	71 (34.1%)	46 (22.1%)	
Feeling in control of exposure: Clearer labelling of GM foods on food packaging	Norway	Not selected	34 (21.8%)	50 (31.6%)	3.887 (1) *
		Selected	122 (78.2%)	108 (68.4%)	
Feeling in control of exposure: More information about what the Norwegian risk regulators are doing to make sure your food is safe	Norway	Not selected	103 (66%)	79 (50%)	8.274 (1) **
		Selected	53 (34%)	79 (50%)	
Feeling confident food is safe: More information about what the Norwegian risk regulators are doing to make sure your food is safe	Norway	Not selected	98 (62.8%)	69 (43.9%)	11.197 (1) ***
		Selected	58 (37.2%)	88 (56.1%)	
Feeling in control of exposure: More information about what the UK risk regulators are doing to make sure your food is safe	England	Not selected	139 (69.5%)	120 (59.4%)	4.468 (1) *
		Selected	61 (30.5%)	82 (40.6%)	

** p < .05 level, ** p < .01 level, *** p < .001 level.*

In Italy and Norway more people who had received the information were more likely to express a preference for an effective system of traceability throughout the food chain to increase confidence about perceived safety than those who had not. In Norway this was also the case for increasing perceptions of control. In Norway and England those who had received the information were less likely to want to know about the activities of the national risk regulators to increase their perception of control than those who had not. In Norway this was also the case for increasing confidence about perceived safety. In Italy confidence in the safety of GM foods was increased with labelling of all GM foods, even if they were similar to those produced by conventional means, if information was received. In Norway those participants in the *information* condition were more likely to select clear labelling of GM foods on food packaging to increase perceived control than those in the *no information* condition (Table 15).

6.5. Section 3 - Attitudes to genetically modified food

This section consisted of thirty-four attitudinal statements, with which participants were required to rate their agreement / disagreement. It was found that between 3.4% and 33.7% of the sample selected the 'I don't know' option for these statements in Italy, with an average of 15.22 %. In Norway between 0.6% and 35.3% of the sample selected the 'I don't know' option for these statements, with an average of 16.51%. Finally, in England between 2.3% and 27.5% of the sample selected the 'I don't know' option for these statements, with an average of 13.16%. Examination of tthose statements where over 20% of the sample selected the 'I don't know' option provides some information about the level of knowledge of the participants. The statements in Table 16 were associated with the highest degree of uncertainty. It appears that about one fifth of the participants were unclear about whether genetic modification of food would lead to certain adverse effects or whether it would be associated with particular benefits (see Appendix 7, Table C).

Table 16. Attitude items where over 20% selected 'I don't know'

	Italy	*Norway*	*England*
Genetically modified foods will last longer	√	√	√
Genetically modifying food causes problems in the food	√	√	√
GM of food will have adverse LT effects on human health	√	√	√
GM of food will adversely affect future generations	√	√	√
GM of food will have adverse effects on animals	√	√	√
GM of food will have adverse ST effects on human health	√	√	√
GM will lead to less pesticide/herbicide use	√	√	√
GM of food will benefit the consumers' health		√	√
Genetically modified foods will have an improved flavour	√	√	√
GM of food adversely affects the food chain		√	
GM of food will lead to cheaper food	√	√	
GM in food production is advantageous to the farmer		√	
GM of food will lead to less wastage of food		√	
GM of food will have adverse effects on the environment		√	

6.5.1. Principal Components Analysis

Principal Components Analysis (PCA) was conducted on the thirty four attitude items with two aims, firstly to investigate whether the attitude items were underpinned by any broader, latent variables, and secondly to allow for data reduction through the creation of subscales which could be used as dependent variables in further analysis. The analysis was conducted on the data for all three of the countries separately. The method of extraction used was principal components and varimax rotation was used to clarify ambiguous loadings. The scree plot was considered to determine the most likely number of components to be extracted.

6.5.1.1. Italy

The amount of variance explained was 50%. Three components emerged from the analysis. The first was composed of items associated with the potential of genetically modified foods for negative effects, and was labelled 'Risks and Negative Effects'. Some of the benefit items loaded negatively onto this component. The second included the remaining items related to the potential benefits associated with genetically modified food and was labelled 'Benefits'. The third was labelled 'Trust and Choice' (Table 17). Subscales were created for the three principal components by taking the means of each item loading onto each PC. Reliability analysis, using Cronbach's alpha as a measure of internal consistency, was applied to see how well the different characteristics loading onto each component were measuring the same psychological construct. The analysis revealed reasonable alphas (Risks and Negative Effects = 0.95; Benefits = 0.69; Trust and Choice = 0.65).

6.5.1.2. Norway

The amount of variance explained was 52%. As before, three components emerged from the analysis. The first was composed of items associated with the potential of genetically modified foods for negative effects, and was labelled 'Risks and Negative Effects'. Some of the benefit items loaded negatively onto this component. The second component was labelled 'Benefits' as it included items related to the potential benefits associated with genetically modified food. The third was labelled 'Trust and Choice' (Table 18). Subscales were created for the three principal components by taking the means of each item loading onto each PC. Reliability analysis, using Cronbach's alpha as a measure of internal consistency, was applied to see how well the different characteristics loading onto each component were measuring the same psychological construct. The analysis revealed reasonable alphas (Risks and Negative Effects = 0.96; Benefits = 0.56; Trust and Choice = 0.63). The reliability for 'Benefits' subscales in both Italy and Norway are quite low. The benefit attitude items included in the study were generated from work conducted in England; it may be that these benefits are not the most relevant to the Italian and Norwegian consumers.

6.5.1.3. England

The amount of variance explained was 56%. As in Italy and Norway, three components emerged from the analysis. The first was composed of items associated with the potential of genetically modified foods for negative effects, and was labelled 'Risks and Negative Effects'. The second included items related to the potential benefits associated with genetically modified food and was labelled 'Benefits'. Unlike the PCAs for Italy and Norway, all of the benefit items loaded onto this item. The third was labelled 'Trust and Choice' (Table 19). Subscales were created for the three principal components by taking the means of each item loading onto each PC. Reliability analysis, using Cronbach's alpha as a measure of internal consistency, was applied to see how well the different characteristics loading onto each component were measuring the same psychological construct. The analysis revealed high alphas (Risks and Negative Effects = 0.96; Benefits = 0.88; Trust and Choice = 0.71).

Table 17. Attitude item loadings following PCA on the Italian data (*NB Please see the Appendices for actual statement wording, GM = Genetic modification)*

Attitude items	*Risks & Negative Effects 33.70%*	*Benefits 8.67%*	*Trust & Choice 7.23%*
GM of food will have adverse long term effects on human health	**0.85**	-0.04	-0.05
GM of food will adversely affect future generations	**0.84**	-0.06	-0.05
GM of food will have adverse effects on animals	**0.82**	-0.11	-0.13
GM of food will have adverse effects on the environment	**0.81**	-0.01	-0.15
GM of food adversely affects the food chain	**0.79**	-0.08	-0.06
The use of GM in food production is risky	**0.79**	-0.17	-0.08
I don't agree with genetically modifying food	**0.78**	-0.13	-0.06
The use of GM in food production is an important risk	**0.76**	-0.04	-0.04
BSE and similar food scares increase my concern about GM	**0.74**	0.06	0.10
I personally worry about the use of GM in food production	**0.73**	-0.07	-0.10
There are unknown side effects of GM of food	**0.71**	0.16	-0.22
The real risks of GM in food production are hidden from consumers	**0.70**	0.03	-0.14
GM of food is interfering with nature	**0.69**	0.04	-0.12
The use of GM in food production makes me wonder what we are eating	**0.68**	0.13	-0.05
Genetically modifying food causes problems in the food	**0.63**	-0.05	-0.02
Profit will come before safety with genetically modified foods	**0.62**	0.11	-0.16
The use of GM in food production is necessary	**-0.57**	0.33	0.34
GM of food will benefit the consumers' health	**-0.56**	0.16	0.44
The use of GM in food production is unethical	**0.55**	-0.22	-0.02
The use of GM in food production is advantageous to the consumer	**-0.53**	0.41	0.24
Public awareness of GM in food should be increased	**0.48**	0.25	-0.17
GM of food will have adverse short term effects on human health	**0.43**	-0.03	0.23
Genetically modified foods will have an improved flavour	**-0.42**	0.14	0.29
Genetically modified foods will last longer	0.02	**0.70**	-0.05
The use of GM in food production is advantageous to the farmer	0.11	**0.63**	-0.07
The use of GM in food production is progressive	-0.19	**0.58**	0.12
GM of food will lead to cheaper food	0.04	**0.56**	-0.06
GM of food will lead to less wastage of food	-0.24	**0.52**	0.21
The use of GM in food production is advantageous to the food industry	0.32	**0.50**	-0.27
GM will lead to less pesticide/herbicide use	-0.07	**0.46**	0.31
The use of GM in food production is avoidable by the consumer	0.08	-0.03	**0.72**
I can choose whether or not to eat food produced using GM	0.03	-0.10	**0.64**
I trust those responsible for regulating the risks of GM in Italy	-0.44	0.24	**0.54**
I trust those responsible for regulating the risks of GM in other countries	-0.47	0.19	**0.53**

Table 18. Attitude item loadings following PCA on the Norwegian data (*NB Please see the Appendices for actual statement wording, GM = Genetic modification)*

Attitude items	*Risks & Negative Effects 37.72%*	*Benefits 7.50%*	*Trust & Choice 7.10%*
GM of food will have adverse long term effects on human health	**0.92**	-0.05	-0.17
GM of food will adversely affect future generations	**0.90**	0.01	-0.13
GM of food will have adverse effects on animals	**0.86**	0.05	-0.08
GM of food will have adverse effects on the environment	**0.86**	0.04	-0.15
I personally worry about the use of GM in food production	**0.83**	-0.10	-0.12
The use of GM in food production is an important risk	**0.82**	0.02	-0.02
I don't agree with genetically modifying food	**0.79**	-0.21	-0.08
The use of GM in food production makes me wonder what we are eating	**0.79**	-0.11	0.03
The use of GM in food production is risky	**0.78**	-0.01	0.04
GM of food is interfering with nature	**0.78**	-0.07	-0.10
GM of food adversely affects the food chain	**0.77**	0.03	-0.02
Genetically modifying food causes problems in the food	**0.73**	-0.19	-0.16
There are unknown side effects of GM of food	**0.73**	0.05	0.08
The use of GM in food production is unethical	**0.73**	-0.17	-0.18
GM of food will have adverse short term effects on human health	**0.70**	-0.14	-0.05
The real risks of GM in food production are hidden from consumers	**0.63**	-0.01	-0.32
GM of food will benefit the consumers' health	**-0.60**	0.27	0.15
BSE and similar food scares increase my concern about GM	**0.58**	-0.04	0.08
The use of GM in food production is necessary	**-0.58**	0.19	0.39
Public awareness of GM in food should be increased	**0.56**	0.05	0.07
The use of GM in food production is advantageous to the consumer	**-0.55**	0.47	0.30
Genetically modified foods will have an improved flavour	**-0.53**	0.38	0.13
Profit will come before safety with genetically modified foods	**0.52**	-0.19	-0.13
The use of GM in food production is progressive	**-0.35**	0.31	0.34
The use of GM in food production is advantageous to the farmer	-0.09	**0.57**	0.20
The use of GM in food production is advantageous to the food industry	0.06	**0.54**	0.01
GM of food will lead to cheaper food	0.09	**0.53**	0.10
Genetically modified foods will last longer	0.09	**0.53**	-0.11
GM of food will lead to less wastage of food	-0.21	**0.52**	0.00
GM will lead to less pesticide/herbicide use	-0.13	**0.50**	-0.06
I can choose whether or not to eat food produced using GM	0.06	-0.18	**0.76**
The use of GM in food production is avoidable by the consumer	0.17	0.07	**0.67**
I trust those responsible for regulating the risks of GM in Norway	-0.36	0.16	**0.61**
I trust those responsible for regulating the risks of GM in other countries	-0.47	0.12	**0.49**

Table 19. Attitude item loadings following PCA for the English data (*NB Please see the Appendices for actual statement wording, GM = Genetic modification)*

Attitude items	*Risks & Negative Effects 34.02%*	*Trust & Choice 13.61%*	*Benefits 8.43%*
GM of food will have adverse long term effects on human health	**0.85**	-0.25	-0.13
GM of food will adversely affect future generations	**0.84**	-0.24	-0.18
GM of food will have adverse effects on animals	**0.84**	-0.22	-0.18
GM of food will have adverse effects on the environment	**0.82**	-0.15	-0.21
GM of food adversely affects the food chain	**0.81**	-0.24	-0.14
Genetically modifying food causes problems in the food	**0.79**	-0.25	0.08
The use of GM in food production makes me wonder what we are eating	**0.79**	-0.17	0.01
There are unknown side effects of GM of food	**0.76**	-0.02	-0.14
The use of GM in food production is risky	**0.75**	-0.12	-0.07
I don't agree with genetically modifying food	**0.75**	-0.29	-0.07
I personally worry about the use of GM in food production	**0.75**	-0.11	-0.08
The use of GM in food production is unethical	**0.74**	-0.24	0.13
GM of food will have adverse short term effects on human health	**0.73**	-0.23	0.04
BSE and similar food scares increase my concern about GM	**0.71**	-0.12	0.07
GM of food is interfering with nature	**0.70**	-0.15	-0.07
Profit will come before safety with genetically modified foods	**0.68**	-0.04	-0.20
The real risks of GM in food production are hidden from consumers	**0.64**	-0.01	-0.14
The use of GM in food production is an important risk	**0.56**	0.14	-0.17
Public awareness of GM in food should be increased	**0.54**	0.09	-0.03
The use of GM in food production is advantageous to the farmer	-0.16	**0.72**	-0.24
Genetically modified foods will last longer	0.07	**0.71**	-0.01
The use of GM in food production is advantageous to the food industry	-0.02	**0.70**	-0.34
GM of food will lead to less wastage of food	-0.02	**0.62**	0.24
GM of food will lead to cheaper food	-0.08	**0.60**	0.25
The use of GM in food production is advantageous to the consumer	-0.43	**0.58**	0.31
The use of GM in food production is progressive	-0.38	**0.55**	0.13
Genetically modified foods will have an improved flavour	-0.30	**0.53**	0.32
GM of food will benefit the consumers' health	-0.32	**0.51**	0.42
GM will lead to less pesticide/herbicide use	-0.10	**0.50**	0.21
The use of GM in food production is necessary	-0.38	**0.47**	0.42
I can choose whether or not to eat food produced using GM	0.04	-0.01	**0.67**
I trust those responsible for regulating the risks of GM in the UK	-0.39	0.27	**0.65**
I trust those responsible for regulating the risks of GM in other countries	-0.37	0.19	**0.65**
The use of GM in food production is avoidable by the consumer	0.10	0.11	**0.60**

6.5.2. Attitudes to GM MANOVAs

Analysis using MANOVA was conducted to investigate the impact of information condition and the demographic variables gender, age and education on attitudes to genetic modification of food as measured by the three subscales. Separate analyses were conducted for each of the three countries due to the differences in the structures resulting from the PCAs.

6.5.3.1. Italy

Analysis using MANOVA indicated that there was no effect of the information condition on attitudes to genetic modification of food as measured by the three subscales (Pillai's Trace $F(3,393) = 0.072$, ns) (Table 20). All three of the univariate F tests (where the dependent variables are examined individually) were also non-significant.

Table 20. Mean (and standard deviation) ratings for the three subscales, by information condition

	Information	*No information*	*F (df)*
Risks and Negative Effects	2.52 (1.08)	2.69 (1.11)	2.639 (1,395)
Benefits	3.34 (1.13)	3.34 (1.08)	0.00 (1,395)
Trust and Choice	4.04 (1.38)	4.26 (1.26)	1.953 (1,395)

Gender

There was no effect of gender on attitude to genetic modification of food in the Italian sample (Pillai's Trace $F(3,393) = 0.638$, ns). All three of the univariate F tests (where the dependent variables are examined individually) were also non-significant (Table 21).

Table 21. Mean (and standard deviation) ratings of agreement by gender

	Male	*Female*	*F (df)*
Risks and Negative Effects	2.66 (1.18)	2.55 (1.01)	1.062 (1,395)
Benefits	3.37 (1.16)	3.32 (1.05)	0.206 (1,395)
Trust and Choice	4.07 (1.40)	4.20 (1.25)	0.978 (1,395)

Age Group

There was a significant difference in attitude between the three age groups (Pillai's Trace $F(6,786) = 3.244$, $p < .01$). Univariate tests were significant for 'Risks and Negative Effects', and 'Trust and Choice', but not 'Benefits' (Table 22). Post hoc analysis indicated that the youngest age group people tended to perceive least 'Risks and Negative Effects'. The youngest group were also more likely to perceive that they could trust the regulators and that they had choice over they exposure to GM food than those in the 35-49 age group.

Table 22. Mean (and standard deviation) ratings of agreement by age group

Attitude Subscale	*18-34 years*	*35-49 years*	*50+ years*	*F (df)*
Risks and Negative Effects	2.91 (1.08)[ab]	2.36 (1.04)[a]	2.52 (1.10)[b]	9.740 (2,394) ***
Benefits	3.32 (1.03)	3.27 (1.08)	3.40 (1.17)	0.577 (2,394)
Trust and Choice	3.91 (1.17)[a]	4.34 (1.49)[a]	4.19 (1.31)	5.754 (2,394) *

** p < .05 level, ** p < .01 level, *** p < .001 level. Means with the same letter by them are significantly different at the p < .05 level (Tukey HSD) for that dependent variable*

Education Level

The effect of level of education on the three attitude scales was analysed, but there was no effect (Pillai's Trace F(3,347) = 2.569, ns). The univariate F tests (where the dependent variables are examined individually) for 'Risks and Negative Effects' and 'Trust and Choice' were also non-significant. However, there was a univariate effect for 'Benefits', this was due to those participants who had been in the education system for longer being more likely to agree that there were benefits associated with GM food, than those participants with less education (Table 23).

Table 23. Mean (and standard deviation) ratings of agreement by education level

Attitude Subscale	*0-5 years*	*>6 years*	*F (df)*
Risks and Negative Effects	2.56 (1.08)	2.64 (1.13)	0.446 (1,349)
Benefits	3.45 (1.15)	3.15 (0.99)	6.879 (1,349) **
Trust and Choice	4.12 (1.30)	4.17 (1.39)	0.131 (1,349)

*** p < .01 level*

6.6.2.2. Norway

Analysis using MANOVA indicated that there was no effect of the information condition on attitudes to genetic modification of food as measured by the three subscales (Pillai's Trace F(3,296) = 0.149, ns) (Table 24).

Table 24. Mean (and standard deviation) ratings for the three subscales, by information condition

	Information	*No information*	*F (df)*
Risks and Negative Effects	2.80 (1.19)	2.86 (1.23)	0.179 (1,298)
Benefits	3.53 (1.13)	3.45 (1.24)	0.291 (1,298)
Trust and Choice	4.18 (1.36)	4.13 (1.30)	0.121 (1,298)

Gender

There was a significant effect of gender on attitude to genetic modification of food (Pillai's Trace F(3,294) = 6.629, p < .001). Additionally, there was a univariate effect (where the dependent variables are examined individually) for 'Risks and Negative Effects' (Table 25). The data indicated that women perceived greater 'Risks and Negative Effects' associated with genetically modified foods compared to men.

Table 25. Mean (and standard deviation) ratings of agreement by gender

	Male	*Female*	*F (df)*
Risks and Negative Effects	3.12 (1.33)[a]	2.55 (1.01)[a]	17.468 (1,296) ***
Benefits	3.43 (1.10)	3.55 (1.26)	0.859 (1,296)
Trust and Choice	4.15 (1.26)	4.14 (1.39)	0.002 (1,296)

*** *p < .001 level. Means with the same letter by them are significantly different for that dependent variable*

Age Group

No differences in attitude between the three age groups were observed (Pillai's Trace F(6,584) = 0.532, ns) (Table 26).

Table 26. Mean (and standard deviation) ratings of agreement by age group

Attitude Subscale	*18-34 years*	*35-49 years*	*50+ years*	*F (df)*
Risks and Negative Effects	2.83 (0.99)	2.74 (1.18)	2.95 (1.47)	0.678 (2,293)
Benefits	3.34 (1.05)	3.63 (1.14)	3.45 (1.40)	1.630 (2,293)
Trust and Choice	4.22 (1.07)	4.15 (1.33)	4.03 (1.57)	0.489 (2,293)

Education Level

The effect of level of education on the three attitude scales was analysed and found to be slightly significant (Pillai's Trace F(3,282) = 3.065, p < .05). The univariate test for 'Risks and Negative Effects' was significant (Table 27). The data indicated that higher perceived risk and negative effects were associated with less time spent in full time education after age 11.

Table 27. Mean (and standard deviation) ratings of agreement by education level

Attitude Subscale	*0-5 years*	*> 6 years*	*F (df)*
Risks and Negative Effects	2.62 (1.03)[a]	3.00 (1.34)[a]	7.151 (1,284) **
Benefits	3.56 (1.22)	3.38 (1.14)	1.705 (1,284)
Trust and Choice	4.11 (1.30)	4.13 (1.36)	0.014 (1,284)

** *p < .01 level. Means with the same letter by them are significantly different for that dependent variable*

6.5.2.3. England

Analysis using MANOVA indicated that there was no effect of the information condition on attitudes to genetic modification of food as measured by the three subscales (Pillai's Trace F(3,383) = 0.436, ns) (Table 28).

Table 28. Mean (and standard deviation) ratings for the three subscales, by information condition

	Information	*No information*	*F (df)*
Risks and Negative Effects	2.74 (1.30)	2.58 (1.39)	1.293 (1,385)
Benefits	4.04 (1.30)	4.12 (1.42)	0.359 (1,385)
Trust and Choice	4.39 (1.49)	4.43 (1.55)	0.092 (1,385)

Gender

There was a significant effect of gender on attitude to genetic modification of food (Pillai's Trace F(3,383) = 10.766, p < .001). Additionally, there were univariate effects (where the dependent variables are examined individually) for 'Risks and Negative Effects', and 'Benefits', but not 'Trust and Choice' (Table 29). The data indicated that women perceived greater 'Risks and Negative Effects' and fewer 'Benefits' associated with genetically modified foods compared to men.

Table 29. Mean (and standard deviation) ratings of agreement by gender

	Male	*Female*	*F (df)*
Risks and Negative Effects	3.02 (1.40)[a]	2.30 (1.19)[a]	29.669 (1,385) ***
Benefits	3.90 (1.38)[a]	4.27 (1.32)[a]	7.134 (1,385) **
Trust and Choice	4.39 (1.55)	4.43 (1.48)	0.067 (1,385)

*** p < .01 level, *** p < .001 level. Means with the same letter by them are significantly different for that dependent variable*

Age Group

Differences in attitude between the three age groups were also observed (Pillai's Trace F(6,764) = 5.237, p < .001). Univariate tests were significant for all three dependent variables (Table 30). Post hoc analysis (using Tukey HSD) indicated that the youngest age group tended to perceive least 'Risks and Negative Effects' and greatest benefits associated with genetically modified foods. Participants in the 50+ age group perceived that they had more choice and trusted regulators more than those in the 35-49 age group.

Table 30. Mean (and standard deviation) ratings of agreement by age group

Attitude Subscale	*18-34 years*	*35-49 years*	*50+ years*	*F (df)*
Risks and Negative Effects	3.09 (1.36)[ab]	2.48 (1.30)[a]	2.40 (1.27)[b]	9.877 (2,383) ***
Benefits	3.77 (1.09)[ab]	4.32 (1.34)[a]	4.16 (1.56)[b]	5.060 (2,383) **
Trust and Choice	4.29 (1.39)	4.69 (1.63)[a]	4.24 (1.49)[a]	2.237 (2,383) *

** p < .05 level, ** p < .01 level, *** p < .001 level. Means with the same letter by them are significantly different at the p < .05 level (Tukey HSD) for that dependent variable*

Education Level

The effect of level of education on the three attitude scales was analysed and found to be significant (Pillai's Trace F(3,368) = 6.749, p < .001). The univariate tests were significant for 'Risks and Negative Effects' and 'Trust and Choice' (Table 31). The data indicated that higher

perceived risk was associated with less time in full time education. These participants also trusted regulators and perceived that they had more choice over their consumption in comparison to those who had spent more time in full time education.

Table 31. Mean (and standard deviation) ratings of agreement by education level

Attitude Subscale	*0-5 years*	*> 6 years*	*F (df)*
Risks and Negative Effects	2.44 (1.31)[a]	2.81 (1.38)[a]	6.578 (1,370) *
Benefits	4.24 (1.48)	4.02 (1.27)	2.347 (1,370)
Trust and Choice	4.17 (1.66)[a]	4.57 (1.40)[a]	6.217 (1,370) *

** p < .05 level.. Means with the same letter by them are significantly different for that dependent variable*

Social Class

Finally, differences in attitude between the four social class groups were also observed (Pillai's Trace F(9,981) = 5.589, p < .001). Univariate tests were significant only for 'Trust and Choice' (Table 32). Post hoc analysis indicated that participants classified into social classes AB and C1 were less trusting of regulators and perceived less choice over their exposure to GM food.

Table 32. Mean (and standard deviation) ratings of agreement by social class

Attitude Subscale	*AB*	*C1*	*C2*	*DE*	*F (df)*
Risks and Negative Effects	2.73 (1.36)	2.65 (1.38)	2.65 (1.46)	2.71 (1.22)	0.075 (3,327)
Benefits	4.14 (1.25)	3.97 (1.41)	4.43 (1.52)	3.94 (1.48)	1.381 (3,327)
Trust and Choice	4.85 (1.37)	4.54 (1.53)	3.87 (1.49)	3.44 (1.36)	13.881 (3,327)***

**** p < .001 level. Means associated with the same letter are significantly different at the p < .05 level (Tukey HSD) for that dependent variable.*

6.6. Section 4 - Information source characteristics associated with trust and distrust

Principal Components Analysis was applied to the mean scores of the five information sources for each country, for each of the nineteen information source characteristics. The results indicated a two component solution (unrotated) provided the best fit, explaining 83% of the variance in total (Table 33). The first component (I), accounted for 69% of the variance. Variables loading positively on this component were *truthful, trustworthy, concerned about public welfare, good track record, accurate information, in favour of using the source, factual information* and *responsibility to provide*. Those variables loading negatively were *withhold information, distorted information, protect self and interests, biased information, vested interest, proven wrong in the past* and. The second component (II), accounted for 14% of the variance. The variables *expert in the area, accountable to others, sensationalised information* and *knowledgeable* loaded positively on this component, and *freedom to provide* loaded negatively (Figure 3).

Table 33. Loadings from the Principal Components Analysis

Source characteristic	*Component I*	*Component II*
Trustworthy	**0.98**	0.07
Distorted information	**-0.97**	0.12
Protect self and interest	**-0.97**	0.13
Factual information	**0.97**	0.17
Concerned about public welfare	**0.97**	-0.13
Accurate information	**0.96**	0.19
In favour of using source	**0.95**	0.05
Proven wrong in the past	**-0.94**	0.07
Withhold information	**-0.94**	0.07
Good track record	**0.93**	0.17
Truthful	**0.93**	0.10
Responsibility to provide	**0.93**	-0.22
Biased information	**-0.91**	0.25
Vested interest	**-0.88**	0.20
Knowledgeable	0.21	**0.89**
Expert in the area	0.31	**0.88**
Freedom to provide	0.53	**-0.67**
Accountable to others	0.37	**0.53**
Sensational information	0.21	**0.35**

Further analysis (using Euclidean and Mahalanobis distances) was conducted to examine the differences between the three countries for each of the sources (see Appendix 8 for more detailed information). The relative placement of the three countries in the factor plot illustrating the relationship between the source characteristics and the sources themselves indicated that England and Italy exhibited similar perceptions of the national government than Norway and either of these countries. The national government in Norway was associated more with 'trust' characteristics than the government in Italy or England. For the scientists involved in developing the technology, it was England that was most different, tending more towards the 'distrust' side of the factor plot; as was also the case for the European Commission. The position of the information source 'Consumer organisation' was relatively similar for the three countries; all three being in the lower, right hand quadrant of the factor space. The position of the food industry was different for each of the three countries.

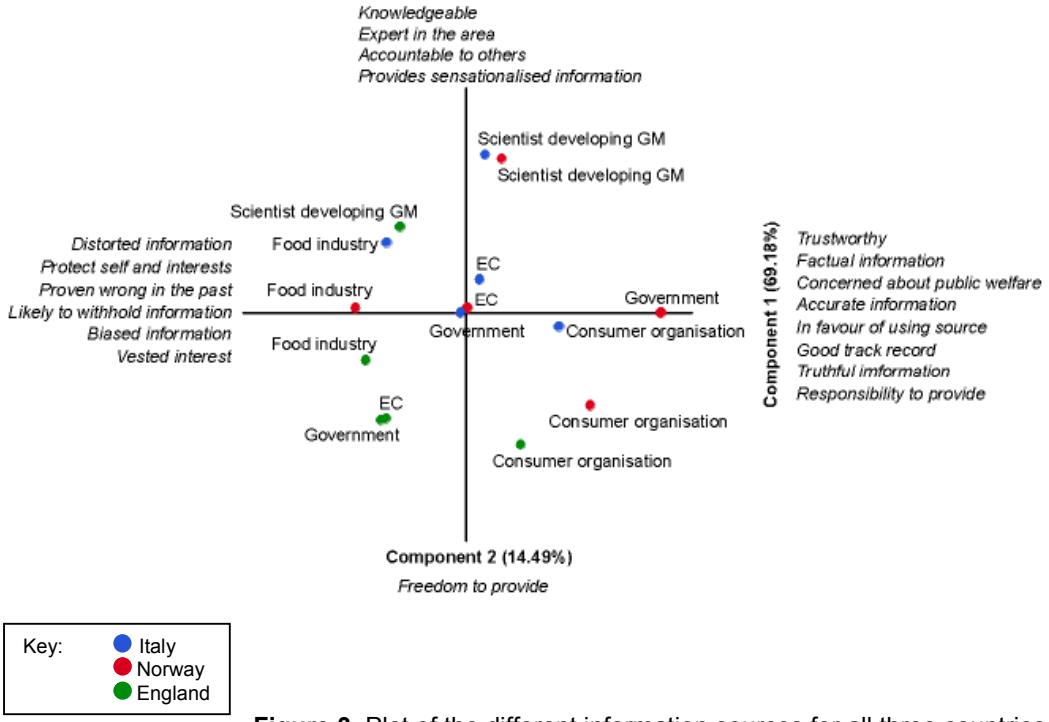

Figure 3. Plot of the different information sources for all three countries in the factor space defined by the two principal components

6.7. Section 4 - Genetically modified food in the media

The participants were asked whether or not they had noticed reports about genetically modified foods in the media; only 58% of the sample had seen reports in Italy, in comparison to 76% in Norway and 88% in England ($\chi^2(2) = 92.874$, $p < .001$). These participants were then asked their opinions about the style and content of the media reports (Figure 4). It can be seen that only half of the sample believed that media reports about genetic modification of food were informative. Media reports were characterised as alarming, sensationalised, usually presenting information about the risks, and tending to present conflict and disagreement. There was no difference between the three countries in ratings of whether the reports were alarming ($\chi^2(2) = 4.957$, ns), and whether they tended to present information about the risks ($\chi^2(2) = 2.980$, ns). However, less people judged the reporting to be sensationalised in Italy ($\chi^2(2) = 22.526$, $p < .001$). Slightly more of the sample judged the information to be informative in Italy, and slightly less in England ($\chi^2(2) = 6.235$, $p < .05$). More of the sample stated that the reporting was balanced, and it tended to present information about the benefits in Italy and less in England (benefits: $\chi^2(2) = 22.218$, $p < .001$; balanced: $\chi^2(2) = 19.011$, $p < .001$). More of the sample judged the reporting to be reassuring in Italy than in the other two countries ($\chi^2(2) = 9.328$, $p < .01$). Less of the Italian sample and more of the English sample judged the reporting to present conflict ($\chi^2(2) = 10.139$, $p < .01$).

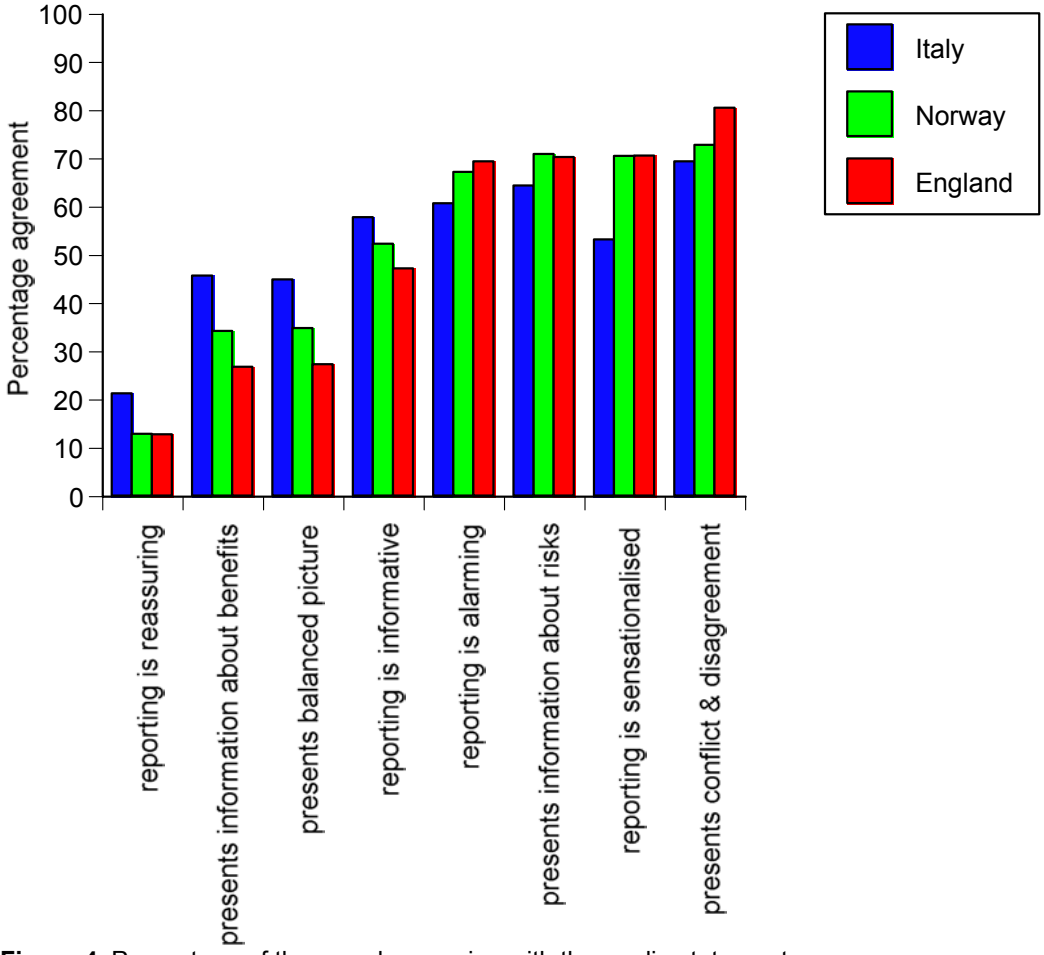

Figure 4. Percentage of the sample agreeing with the media statements

7. Results summary

Attitudes to labelling of GM food

- Most people had heard of genetic modification or genetically modified food independent of whether they lived in Norway, Italy or the UK.
- Overall, about 40% of people claimed that they would not buy GM food, whereas 40% would *possibly* buy GM food. Few people said they would definitely buy it.
- People believed that *labels should state if food or ingredients have been genetically modified*, *that processed food derived from GM crops should be labelled*, and that GM and non-GM crops should be *kept separate at all stages of processing*.
- Over 95% of the Italians and Norwegians claimed to *check food labels for information about genetic modification*. This was in contrast to only 62% in England. However, over 60% of the English sample were aware that the UK supermarkets had removed GM ingredients from their own brand products. The English consumers claimed they would check food labels more frequently if this was not the case.
- Most people wanted labelling even under conditions where less than 1% GM material was included as an ingredient, even if this was through accidental contamination. The

exception was Norwegian consumers, some of whom were not concerned about the need to label for very low levels of contamination.

Perceived risk, benefits, and control over exposure

- The majority of people in all three countries did not know if GM would cause harmful health effects nor whether there were currently any benefits to consumers from GM food. Those consumers convinced of negative effects believed that there *were harmful health effects and no benefits*. Italians in particular were not convinced of the benefits of GM foods.
- The Norwegians perceived *less control over their exposure to GM food* than people in the other two countries.
- The Italians were more likely to believe that they and other people would experience harmful health effects from consuming GM foods. Furthermore, they believed that these harmful health effects were more serious in comparison to consumers in the other two countries. They were also less convinced of the benefits to consumers from GM food than the Norwegians.
- There was no effect of receiving information about traceability and detection methods on attitudes about risk, benefit, perceived control and trust. One exception to this was observed. People in England receiving the information about traceability were more likely to believe that genetic modification would benefit consumers in the future than those who did not receive the information.

Improving perceived control and confidence in safety of GM food

- People in all three countries wanted "*clearer labelling of GM foods on food packaging*", "*more information about how food and ingredients were genetically modified*" and "*more information about any associated risks*" to enable them to feel in control over their exposure to GM food and to feel more confident that genetically modified food product in the shops are safe.
- The English, in particular, expressed a preference for an effective system of traceability throughout the food chain.
- In Italy and Norway, people who had received the information about traceability and detection methods expressed a preference for an "effective system of traceability throughout the food chain" to increase confidence about perceived risk. In Norway this was also the case for increasing perceptions of control.

Attitudes to GM food

- Analysis indicated that attitudes to GM food in all three countries could be reduced to three groups: "Risks and Negative Effects", "Benefits" and "Trust and Choice". The structure of these groups was slightly different between the three countries, with more similarity between Italy and Norway.

- There were differences in attitudes to GM food according to demographic characteristics, although these were not profound and consistent with previous research (e.g. Frewer, Hedderley, Howard and Shepherd, 1997; Siegrist, 1998).

Trust in information sources

- There were cross-cultural differences in perception of the different information sources. The Norwegians were most trusting of scientists and their own government, and the Italians were most trusting of the European Commission. The English were least trusting of all three information sources.
- The national government in Norway was more associated with the 'trust' characteristics, than the national government in Italy and, particularly, in England.
- In Italy and England the EC and the national government were perceived very similarly, in contrast in Norway the national government was far more trusted than the EC.
- The food industry was associated with 'distrust, independent of the nationality of consumers sampled.
- The scientists developing GM technology were viewed more favourably in Italy and Norway than in England.
- Consumer organisations were associated with 'trust' characteristics. In England they were particularly associated with having the "freedom to provide" information to the public.

Genetic modification in the media

- Fewer people in Italy had noticed reports about genetically modified foods in the media than in Norway and England. Only half of the sample believed that media reports about genetic modification of food were informative. Media reports were characterised as alarming, sensationalised, usually presenting information about the risks, and tending to present conflict and disagreement.

8. Discussion

The hypothesis that providing information about traceability and improved scientific detection methods would consumer confidence in genetically modified foods was not supported. However, many people appreciated the benefits of an effective system of traceability for GM food throughout the food chain. English people perceived that this would increase their perceptions of control over exposure to GM food and enable them to feel confident that GM products in the supermarkets were safe, irrespective of whether they had received information about traceability methods. In addition, people in Italy and Norway who received information about traceability and detection methods recognised the benefits of these mechanisms and expressed a desire for an effective system of traceability throughout the food chain. Thus dissemination of information about traceability of GM foods and ingredients is likely to be regarded as a positive development as far as consumers are concerned.

The majority of people in all three countries did not know if GM would cause harmful health effects nor whether there were currently any benefits to consumers from GM food. However, there was a consensus amongst those who did have an opinion that there were harmful health effects and no benefits associated with genetically modified foods. At the time of data collection, the consumers included in the study were divided about whether they would buy genetically modified products or not. However, the results appear to indicate that failing to develop an effective labelling strategy related to increased knowledge about GM ingredient traceability would eliminate consumer choice and result in more consumer negativity associated with GM technology applied to food production. In particular, people expressed a preference for such a strategy to address GM processes used in production, as well as GM foods and ingredients. This mitigates against the utilisation of substantial equivalence as a basis for labelling, despite the simpler operational characteristics of such an approach.

Furthermore, people wanted GM food and ingredients to be *labelled irrespective of the amount of GM material contained*. There was little difference between the three European countries in this respect, despite differences in actual concerns between the different countries. This implies that labelling policy is best instigated at a European wide-level, rather than differentially developed at the level of different European Member States. The results of this study imply that it would be appropriate to harmonise Norwegian policy with that of the European Community. Such a labelling policy needs to be developed in conjunction with more effective information dissemination practices. It should be noted that cross-national differences in people's concerns exist between different countries – effective communication practices SHOULD take account of these differences, and the development of information strategies might represent the point where policy development is localised in order to take account of these local differences.

An interesting observation was that Norwegians exhibited high levels of trust in their national government, in contrast to that exhibited by consumers in Italy and the UK. Although the determinants of trust and distrust are well understood, it is not clear from these results why Norwegian's trust in their government is so high. Further research might usefully focus on understanding differences in institutional practices which result in public trust and distrust in regulatory activities and dissemination activities. Once these are understood, best practice in risk management and strategic development of science can be developed, and clearer recommendations made regarding institutional reform and the creation of new institutions under conditions where public trust in institutional activity is important.

Finally, the results suggest that the importance of the media in creating consumer negativity associated with emerging technologies such as GM foods may have been somewhat exaggerated. The consumers surveyed appeared to view the media as having portrayed the

introduction of GM food in a negative and somewhat sensationalist manner. However, previous research has demonstrated that the impact of the media on people's risk perceptions and related attitudes is not great, and certainly not long-lived (Frewer, Miles and Marsh, in press). Thus, an open and transparent system of labelling associated with GM foods and ingredients, coupled with effective traceability mechanisms, will provide the best basis for consumer choice regarding the consumption of GM foods. Information provided by the media is likely to be regarded as sensationalist in the long-term.

9. Conclusions and policy implications

Consumer response to the development of an effective system of traceability for GM food and ingredients throughout the food chain was generally very positive, although it did not specifically influence people's attitudes towards genetically modified foods. However, failure to implement an effective traceability strategy for genetically modified foods and ingredients may have a negative long-term impact on consumer confidence in food security, particularly in the current climate of consumer distrust in food safety, science and risk regulation.

1. As traceability mechanisms are developed, this information should be placed in the public domain. Similarly, incidents of cross-contamination between GM and non-GM ingredients should be reported to the public as soon as they occur.

Failing to develop an effective labelling strategy, which takes due account of accidental contamination, would eliminate consumer choice and result in more consumer negativity towards genetically modified products. People want food and ingredients to be *labelled irrespective of the amount of GM material contained*.

2. It is recommended that a labelling strategy be developed and implemented as soon as technically feasible.
3. Research may be needed to determine the most effective form for food labels, which take due account of cross-cultural differences in information preferences, if these exist.
4. There was a clear preference for labelling of products on the basis of both process and product characteristics. This mitigates against the *utilisation of substantial equivalence* as a basis for labelling practices.
5. The lack of differentiation between the different European member states implies that the development of labelling policy will be most effective at a European level, as opposed the development of individual labelling policies in each European member state separately. In the case of Norway, it may be useful to develop a national policy harmonised with the European Community model.
6. Such a labelling policy needs to be developed in conjunction with more effective information dissemination practices.

7. An open and transparent system of labelling regarding GM foods and ingredients, coupled with effective traceability mechanisms, will provide the best basis for consumer choice regarding the consumption of GM foods. Information provided by the media is likely to be regarded as sensationalist and unduly negative in the long-term.
8. Future research might usefully focus on why such profound cross-cultural differences in trust in different institutions and information sources exist. This information might be used to understand the best way to instigate institutional reform and structure in order to regain consumer confidence in food security (for example, in the case of the developing European Food Agency, and more widely as part of the emerging "science and society" agenda).

10. References

Bord, R.J and O'Connor, R.E. (1992). Determinants of risk perceptions of a hazardous waste site. *Risk Analysis,* **12**(3), 411-416.

Cvetkovich, G. and Löfstedt, R.E. (1999). Introduction. In: G. Cvetkovich and R.E. Löfstedt (Eds), *Social Trust and the Management of Risk*. Earthscan: London. pp.1-21.

Ellahi, B. (1995). UK National Consensus Conference on plant biotechnology. *Trends in Food Science and Technology,* 6, 35-41.

Eurobarometer (2001). Eurobarometer 55.2: Europeans, science and technology. http://europa.eu.int/comm/dg10/epo/eb/eb55/eb552_sctech.html

Fife-Schaw, C. and Rowe, G. (1996). Public perceptions of everyday food hazards: A psychometric study. *Risk Analysis*, 16(4), 487-500.

Frewer, L.J., Hedderley, D., Howard, C. and Shepherd, R. (1997). 'Objection' mapping in determining group and individual concerns regarding genetic engineering. *Agriculture and Human Values*, 14, 67-79.

Frewer, L.J., Howard, C. and Shepherd, R. (1997). Public concerns in the United Kingdom about general and specific applications of genetic engineering: Risk, benefit and ethics. *Science, Technology and Human Values,* 22(1), 98-124.

Frewer, L.J., Howard, C., Hedderley, D. and Shepherd, R. (1996). What determines trust in information about food related risks? Underlying psychological constructs. *Risk Analysis*, 16, 473-486.

Frewer, L.J., Miles. S. and Marsh, R. (in press). The media and genetically modified foods: Evidence in support of social amplification of risk. *Risk Analysis*.

Frewer, L.J. and Shepherd, R. (1995). Ethical concerns and risk perceptions associated with different applications of genetic engineering: Interrelationships with the perceived need for regulation of the technology. *Agriculture and Human Values,* 12(1), 48-57.

Frewer, L.J. and Shepherd, R. (1998). Consumer perceptions of modern food biotechnology. In: S. Roller and S. Harlander (Eds.), *Genetic Modification in the Food Industry: A Strategy for Food Quality Improvement*. Blackie Academic and Professional: London. pp.27- 46.

Gaskell, G., Allum, N., Bauer, M., Durant, J., Allansdottir, A., Bonfadelli, H., Boy, D., de Cheveigné, S., Fjaestad, B., Gutteling, J.M., Hampel, J., Jelsøe, E., Jesuino, J.C., Kohring, M., Kronberger, N., Midden, C., Nielsen, T.H., Przestalski, A., Rusanen, T., Sakellaris, G., Torgersen, H., Twardowski, T. and Wagner, W. (2000). Biotechnology and the European public. *Nature Biotechnology*, 18, 935-938.

Gaskell, G., Bauer, M.W. and Durant, J. (1998). Public perceptions of biotechnology in 1996: Eurobarometer 46.1. In: J. Durant, M.W. Bauer and G. Gaskell (Eds.), *Biotechnology in the Public Sphere: A European Sourcebook*. Science Museum: London, pp.189-214.

Hunt, S., and Frewer, L.J. (2001). Impact of BSE on attitudes to GM food. *Risk Decision and Policy*, 6, 91-103.

Johnson, B.B. and Slovic, P. (1995). Presenting uncertainty in health risk assessment: Initial studies of its effects on risk perception and trust. *Risk Analysis,* **15**(4) 485-494.

Jones, P., Clarke-Hilll, C., Hillier, D. and Shears, P. (2000). Food retailers' responses to the GM controversy within the UK. *British Food Journal*, 102(5/6), 441-448.

Lassen, J., K.H. Madsen, and P. Sandøe (2002), Ethics and genetic engineering - lessons to be learned from GM foods. *Bioprocess Biosystems Engineering*, 24(5), 263-271.

Miles, S. and Frewer, L.J. (2001). Investigating specific concerns about different food hazards. *Food Quality and Preference* 12(1), 47-61.

Miles, S. and Frewer, L.J. (in press). Public perception of scientific uncertainty in relation to food hazards. *Journal of Risk Research*.

Reynolds, C. (1997). Helping people think about biotechnology. *BNF Nutrition Bulletin,* 22, 25-31.

Rosati, S. and Saba, A. (2000). Factors influencing the acceptance of food biotechnology. *Italian Journal of Food Science*, 4(12), 425-434.

Saba, A. and Vassallo, M. (2002). Consumer attitudes toward the use of gene technology in tomato production. *Food Quality and Preference*, 13, 13-21.

Saba, A., Moles, A. and Frewer L.J. (1998). Public concerns about general and specific applications of genetic engineering: A comparative study between the UK and Italy. *Nutrition and Food Science,* 1, 19-29.

Saba, A., Rosati, S. and Vassallo, M. (2000). Biotechnology in agriculture. Perceived risk, benefits and attitudes in Italy. *British Food Journal*, 102(2), 114-121.

Scholderer, J., Balderjahn, I., Bredahl, L. and Grunert, G.K. (1999). The perceived risks and benefits of genetically modified food products: Expert versus consumers. In: B. Dubois, T. Lowrey, L.J. Shrum and M. Vanhuele (Eds.), *European Advances in Consumer Research (Vol. IV)*. Association of Consumer Research: Provo, UT, pp. 123–129.

Scholten, A.H., Feenstra, M.H. and Hamstra, A.M. (1991). Public acceptance of foods from biotechnology. *Food Biotechnology*, 5(3), 331-345.

Select Committee on Science and Technology (1999). Scientific Advisory System: Genetically modified foods HC286, First Report, Session 1998-99. Government Response. Cm 4527.

Siegrist, M. (1998). Belief in gene technology: The influence of environmental attitudes and gender. *Personality and Individual Differences,* 24(6), 861-866.

Siegrist, M., Cvetkovick, G. and Roth, C. (2000). Salient value similarity, social trust, and risk/benefit perception. *Risk Analysis,* **20**(3), 353-362.

Slovic, P. (1993). Perceived risk, trust and democracy. *Risk Analysis,* **13**(6), 675-682.

Slovic, P., Fischhoff, B. and Lichtenstein, S. (1980). Facts and fears: Understanding perceived risk. In: R.C. Schwing and W.A. Albers (Eds.), *Societal Risk Assessment: How safe is safe enough?* Plenum: New York. pp.181-216.

Sparks, P. and Shepherd, R. (1994). Public perceptions of the potential hazards associated with food production and food consumption: An empirical study. *Risk Analysis,* 14(5), 799-806.

Sparks, P., Shepherd, R. and Frewer, L.J. (1994). Gene technology, food production and public opinion: A UK study. *Agriculture and Human Values,* 11, 19-28.

Zimmerman, L., Kendall, P., Stone, M. and Hoban, T. (1994). Consumer knowledge and concern about biotechnology and food safety. *Food Technology*, November, 71-77.