COMMUNICATING THE RISKS AND BENEFITS OF GENETICALLY ENGINEERED FOOD PRODUCTS TO THE PUBLIC:

THE VIEW OF EXPERTS FROM FOUR EUROPEAN COUNTRIES

MAPP

Working paper no 57

September 1998

CENTER FOR MARKEDSOVERVÅGNING, -VURDERING OG -BEARBEJDNING TIL FØDEVARESEKTOREN · ÅRHUS
CENTRE FOR MARKET SURVEILLANCE, RESEARCH AND STRATEGY FOR THE FOOD SECTOR · AARHUS · DENMARK

Communicating the risks and benefits of genetically engineered food products to the public:

The view of experts from four European countries

Joachim Scholderer
Ingo Balderjahn
Simone Will
University of Potsdam
Department of Marketing

PREFACE

This report presents the results of the first empirical task in the cross-national project *Consumer Attitudes and Decision-making with Regard to Genetically Engineered Food Products* (CADE-GENTECH), funded by the European Commission through contract number FAIR-PL96-1667. The project is co-ordinated by Professor Klaus G. Grunert, The MAPP Centre at The Aarhus Business School, Denmark. The participating organizations include the Technical Research Centre of Finland; Oy Panimolaboratorio-Bryggerilaboratorium, Finland; Chr. Hansen A/S, Denmark, University of Potsdam, Germany; ISIDA, Italy; and the Institute of Food Research, Great Britain.

The authors wish to thank Lone Bredahl and Professor Klaus G. Grunert at The MAPP Centre, Dr Francesco Guadalupi at ISIDA, and Dr Pamela Pauwels and Dr Lynn Frewer at the Institute of Food Research for arranging the local focus groups, as well as for transcribing, translating, and coding the data. Without their help, finishing the study would certainly have taken us another couple of months. As dedicated quantitative researchers, we are (probably!) also indebted to all those who were still listening patiently when our traumatic experiences with qualitative data had already reached a nerve-racking level. Finally, we wish to thank all those who participated in the focus group discussion. Their contribution is the very substance of our study.

All correspondence concerning this paper should be addressed to Joachim Scholderer, University of Potsdam, Department of Marketing. August-Bebel-Strasse 89, D-14482 Potsdam, Germany. Email: scholder@rz.uni-potsdam.de.

Joachim Scholderer, Ingo Balderjahn, and Simone Will

May 1998

EXECUTIVE SUMMARY

1. Previous research on the risks and benefits of genetically engineered food products has not accounted for risk communication issues. The introductory part of this paper develops a more comprehensive model. Risks and benefits enter the model as the input of a risk communication process. The relevant actors transfer the raw information into a series of messages, subjecting it to varying degrees of correctness, completeness, comprehensibility, and (although less deliberately) credibility. Successful implementation depends on the constructive interaction between the involved actors, reaching relevant target groups, and achieving dialogue with the consumer. On the consumer side, different variables can be affected: knowledge and problem awareness as cognitive dimensions, attitudes and trust as evaluative dimensions.

2. Expert focus groups were conducted in Denmark, Germany, Italy, and the United Kingdom. Leading representatives of the following parties took part: scientific research, authorities responsible for the approval of genetically modified organisms, suppliers of genetically modified organisms, the food processing industry, associations of the food industry, agricultural organizations, retail, media, professional communication agencies, consumer organizations, and environmental organizations. Altogether, 48 experts participated in the study. Data were classified according to a category system derived from the risk communication model and subjected to further qualitative analyses.

3. Results indicate that most products that have already entered the European market are perceived as a first generation whose quality attributes pertain to improved cultivation, processing, and distribution characteristics, resulting in price advantages that can be transferred to consumer markets. Many producers hope that the second generation will take over the market for functional foods. Indeed, the second generation is still missing. Potentials for a more sustainable production should meet the increased ecological awareness of European consumers. However, many experts perceive a biased perspective in the public, based on moral rather than ecological concerns.

4. Cross-national differences between the four involved countries are not very pronounced. Results suggest a temporally delayed onset of the risk discussion in Italy. In the northern EU countries, the expert community has already shifted from the public discussion of risks to the communication of benefits.

5. Six prototypical communication strategies are identified: the scientific information approach, the balanced information approach, the product information approach, classical advertising, restoring credibility, and reassuring the target audience. The former three aim at the cognitive dimensions, the latter three are persuasion approaches and aim at evaluative dimensions. Existing empirical evidence is considered for a preliminary valuation of the strategies. However, further research is needed to judge their effectiveness with regard to communication about genetically modified food products.

INTRODUCTION

The public debate on the use of recombinant DNA techniques in agriculture and food processing has extensively covered the associated risks and benefits. Recall, for example, some of the potential risks to which the critics have passionately alerted the general public (surely, the list is incomplete):

- Ethical considerations, such as general questionability of manipulating creation, or, more specifically, animals suffering due to health problems resulting from unintentional side effects of foreign gene introduction.

- Possible health risks such as allergies, antibiotic resistance, or lowered nutritional content of foods due to changes in the genetic makeup of plants and animals or treatment with genetically-engineered products.

- Potential ecological upset due to unintended gene transfer into wild populations.

- Possible loss of plant diversity.

- Devastation of already fragile third world economies by take-over of markets for natural, unaltered agricultural products.

On the other hand, the proponents do not grow tired of stressing the potential benefits of genetic engineering:

- Enhanced processing safety, for example in cheese production.

- New plant and animal varieties which could improve flavour and texture, disease, pest, and drought resistance, storage and transportation capacity, or nutritional content.

- Potential reduction in use of harmful chemicals for fertilisers and pesticides, resulting in a cleaner environment.

- Lower prices for consumers.

- Lower risk of starvation periods in third-world countries due to transgenic plants which are resistant to environmental stress factors.

By means of literature review as well as expert interviews, Smink and Hamstra (1994) made a heroic attempt to compile the consumer-relevant risks, benefits, and debatable effects of modern biotechnology on food production *completely*. Our study is not going to repeat their task. Going beyond a mere listing of risks and benefits, we will incorporate them into a communication model and investigate possible risk communication strategies as perceived by the European expert community in late 1997.

The following sections will develop a dynamic perspective on the public debate about genetically engineered food products. Smink and Hamstra's utility aspects enter our model as the input of a risk communication process: the relevant actors transfer the raw information into a series of messages, subjecting it

to varying degrees of correctness, completeness, comprehensibility, and (although less deliberately) credibility. Successful implementation depends on the constructive interaction between the involved actors, as well as on reaching the relevant target groups and achieving dialogue with the consumer. On the consumer side, different variables can be affected: knowledge and problem awareness as cognitive dimensions, attitude and trust as evaluative dimensions.

Before going into detail, we will briefly review some sociological models of risk, providing a more 'macro' perspective on communication about genetically engineered food products, and embedding risk communication programs in a social context.

Individual and social perspectives on risk

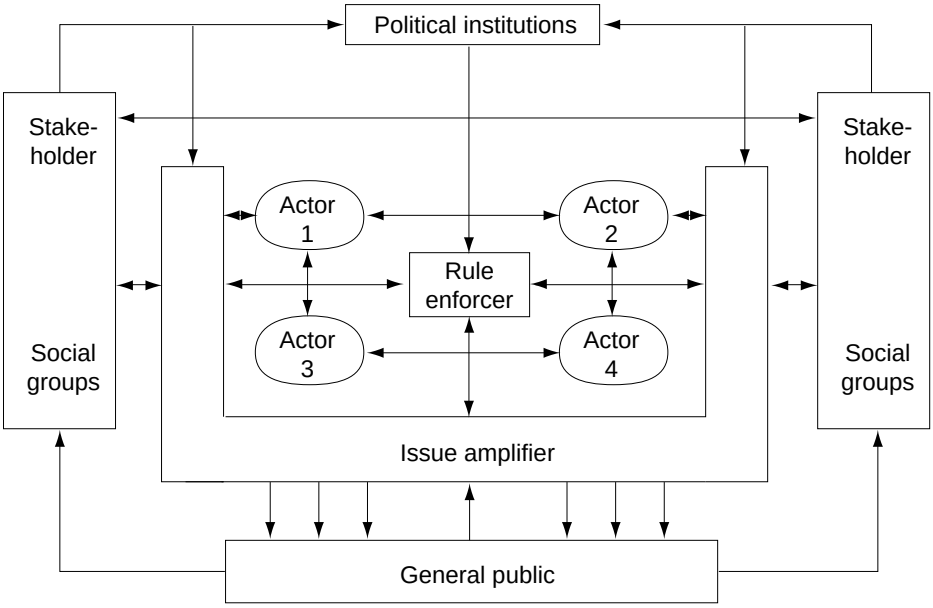
Research on the public perception of risks has traditionally focused on the individual level, trying to determine which characteristics of a potential hazard can predict whether an individual will judge it as more or less risky. The literature lists up to 25 such dimensions, the most important ones including involuntary versus voluntary, artificial versus natural, exotic versus familiar, dread versus not dread, focused in time and space versus diffuse in time and space, controlled by the system versus controlled by the individual, unfair versus fair, morally relevant versus morally irrelevant, and untrustworthy sources versus trustworthy sources. Studies of this kind have been subsumed to the collective label 'psychometric approach to risk perception'; an excellent review of both its history and its central results can be found in Slovic (1992).

The *diffusion* of risk information, however, is an essentially social phenomenon. A number of models have been proposed to account for the characteristics that transform some risks into severe public crises, whereas othes – even when their expected mortalities are immensely higher – completely fail to call for attention.

Kasperson, Renn, Slovic et al. (1988) incorporate the effects of media coverage, special interest groups who place a particular risk on their agenda, and the so-called signal value of singular events (eg, accidents), into a process model. Succinctly termed 'the social amplification of risk', the model describes the step-by-step diffusion of an initial risk event through different channels to the collective and individual recipients. On its way, the signal is selectively amplified and filtered, causes ripple effects, and is valued according both to its psychosocial and economic impacts on the affected parties (see also Renn, Burns, Kasperson et al., 1992; Rip, 1988; Svenson, 1988 for an extended discussion of the model).

Other concepts focus on the interaction between the involved parties. Renn (1992a, b) applies the social arena model to risk debates. The arena metaphor generally stands for the process of policy formation and enforcement, incorporating the interaction and conflict of those social actors who are intended to influence collective decisions or policies (Dickson, 1984; O'Riordan, 1983). In the heart of the respective arena, a rule enforcement agency (eg, a governmental institution or a press agency) controls the struggle between the relevant actors. Several issue multipliers (the media) interpret the interaction and transmit the realigned information to a larger audience (the stakeholders and the general public). Figure 1 gives a graphic representation of the model.

Figure 1. The social arena model applied to risk debates (Renn, 1992b, p. 183). Arrows indicate communication flow between the respective actors.



Mobilisation and exchange of various social resources are the instrumentalities behind the struggle in the arena: "*Money provides incentives (or compensation) for gaining support; power is the legally attributed right to impose a decision on others; social influence produces a commitment to find support through solidarity; value commitment induces support through persuasion and trust; and evidence can be used to convince persons about the likely consequences of their own action. Resources are not the ends of the actors, but the means to accomplish their goals*" (Renn, 1992a, p. 503).

The different resources are viewed as compensatory. An environmental organisation could, for example, exchange the resource 'evidence' for the resource 'value commitment': Since technology assessments are uncertain by nature, there will always be partially conflicting scientific evidence. Maintaining a fundamentally rejective technology policy would then probably enhance the organisation's trustworthiness, because fundamental rejection is, of course, a highly consistent policy.

The resulting loss in adaptation to new evidence could easily be overcome, because science is always open to conflicting evidence and thus also to partially inconsistent information. As the example shows, macro models like the social arena concept are perfectly suitable as a frame of reference, providing a view on the social context of risk communication that would not be possible with the more reductionist approaches from psychology. However, macro models begin to suffer from their generality when a more detailed view is required. The next sections will try to make the communication flows in the model a bit more explicit, specifying *what* is communicated, *who* communicates, and *how* this is done.

Consumer-relevant risks and benefits of genetically engineered food products

A considerable amount of research on the subject has already been done at the SWOKA Institute for Consumer Research in the Netherlands. Smink and Hamstra (1994) present a systematic review and classification of the consumer-relevant risks and benefits of genetically engineered food products, a series of expert interviews, and an attempt to model the communication flow between the relevant actors in three European countries.

The first three aspects of their classification closely resemble the classic fields of risk communication: safety, health, and environment. Moral values provide an account of consumers' fundamental acceptance or rejection of genetic engineering, whereas price and quality are the more product-related utility dimensions from marketing science. Social usefulness and distribution of benefits are criteria for judging the aggregate utility of genetic engineering, in terms of overall benefit for an economy, and in terms of dispersion over actors. Information is, of course, the input, whereas freedom of choice and decision power over foodstuffs specify the extent to which an actor participates and the role he plays in social choice over genetic engineering in food production. Table 1 lists the most important risks and benefits that can be found in the existing literature.

Table 1. Risks and benefits of genetically engineered food products

	Benefits	Risks
Safety	• Quick and exact food safety tests • Production of pure substances • Protection against contamination during processing	• Unknown interactions between genes (position effects) • Carry-over of marker genes expressing antibiotic resistance • Unknown effects due to spontaneous mutation in tissue cultures
Health	• Improved nutritional value • High-protein products as alternatives to meat • Dairy products containing low or no lactose • Disease prevention in third-world countries	• Fat substitutes impair resorption of fat-soluble vitamins • Increase in one component might result in decrease in other components • Expression of allergenic proteins
Environment	• Reduced energy expenditure and immission due to enzymatic processing • Reduction in pesticide use • Applicability of easily degradable non-selective herbicides • Lower amount of dung due to more efficient milk production • Decreased need for fertiliser • Reuse of waste via biomass conversion • Reduced loss during storage and transportation • Reduced energy expenditure due to reduced need for cooling	• Application of pest resistant crops may induce loss of natural pesticides via quicker development of resistance in insects • Increase in large-scale agriculture will impair sustainable development • Transfer of resistance genes to other plants • Genetically modified organisms might themselves become a pest • Loss of genetic variety due to non-selective herbicides

Table 1. Risks and benefits of genetically engineered food products (continued)

Moral values	•Improvement of animal health and animal welfare by implementation of disease resistance •Micro-organisms producing enzymes replace extraction from animals	•Fundamental obligation to preserve creation •Intrinsic value of animals is negatively affected •Biotechnology alienates the consumer from the product
Price	•Price-performance ratio will be enhanced	•Prices will not decrease due to monopolistic tendencies
Quality	•Higher quality on constant level •Improved taste and flavour •Availability of natural additives •Longer shelf life and storage •Improved sensory quality •Enhanced product differentiation	•Definition of quality is subject to trends, and the current trends define quality by attributes of traditionalness
Social Usefulness	•Technical support for solution of environmental problems	•Technological solutions tend to mask underlying problems
Distribution of benefits	•Plant and animal varieties can be produced more independent of environmental constraints •More reliable cultivation of genetically modified crops in third world countries	•Producers become more dependent of patent-holders •Biotechnological production of raw materials threatens third-world economies •Patent protection is largely absent in third world countries •Research is only directed at yield enhancement and efficiency
Information	•Labelling provides freedom of choice	•Consumers lack knowledge about genetic engineering, so labelling will not provide understanding •Consumers cannot interpret differences between production techniques •Labelling of additives and ingredients is not prescribed •Providing information causes large costs
Freedom of choice	•Increasing variety of products	•Lack of information makes free choice impossible •Large-scale use of genetic engineering will affect nearly all products
Decision power over foodstuffs	•Increasing power of retail firms who take consumer wishes into account	•Direct consumer influence in decision-making process concerning food production is practically absent

Indeed, these risks and benefits can only become relevant to consumer decision-making when they are communicated. So far, the public discussion has focused on *labelling,* which is the legally prescribed way of product-related information. The Novel Food Directive clearly states that products actually containing genetically modified organisms have to be labelled, but not necessarily ones that were only produced with the help of genetically modified organisms, but do not contain them anymore. This may become ambiguous in cases where no generally accepted scientific methods exist by which the inclusion of modified genes can be proved, or when the modifications are not 'essential' with regard to nutritional value, metabolism, or amount of undesirable contents. On the other hand, the directive stresses that no producer will be prevented from labelling even when it would not be legally prescribed.

Obviously, a wide range of communication strategies is possible. Communication strategies, in turn, depend on those actors who initiate them, those who implement them, and those actors they are directed at. The following section will provide the 'cast' of the debate and review some preliminary evidence for different strategies.

Relevant social actors

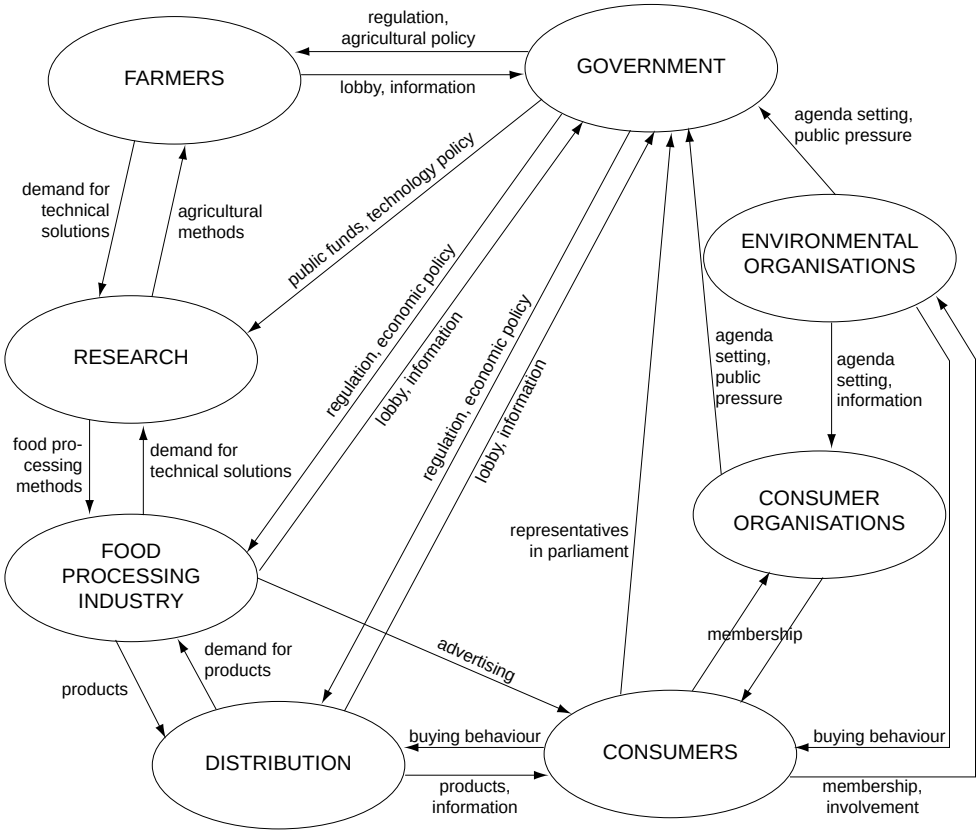
Smink and Hamstra (1994) identify eight social actors in the public debate on genetically engineered food products: government, research, farmers, food processing industry, distribution, consumers, consumer organisations, and environmental organisations. Figure 2 shows the results of their analytical exercises.

In a subsequent study, Smink and Hamstra (1996) conducted 33 interviews with representatives of producers, retailers, environmental and consumer organisations in several European Union (EU) countries. Among the interviewed producers, especially those dealing with ingredients and seeds indicated that they did not feel it was their obligation to provide the consumers with all the relevant information. Instead, they would prefer to inform their actual customers. They generally agreed that information should be provided to those who are interested, for example by means of brochures, meetings, public hearings, discussions, etc. Most producers preferred labelling only in cases where the product essentially differs from the original product.

The representatives of non-governmental organisations agreed that in principle consumers must be able to differentiate all products that have by any means been in contact with genetic engineering, and most of them also agreed that this should be realised by labelling these products, even if this would cause practical problems. Furthermore, all involved actors should engage in informing the consumers about biotechnology in food production.

The retailers' attitudes towards labelling showed considerable variation. Some of them agreed with the producers that only essential modifications should be labelled, some indicated that they would label all products that had been in contact with genetic engineering, and some indicated they would provide private labels and separate shelves in their shops.

Figure 2. Lines of influence between the relevant social actors in the public debate on genetically engineered food products (Smink & Hamstra, 1994, p. 43)



Evaluating risk communication

The arena model draws heavily on information and resource flows, incorporating concepts like evidence, support, persuasion, and trust. Focusing on a distinct communication program, these concepts can be identified with different stages in the process. Rohrmann (1992) presents a detailed list of criteria for the evaluation of risk communication programs.

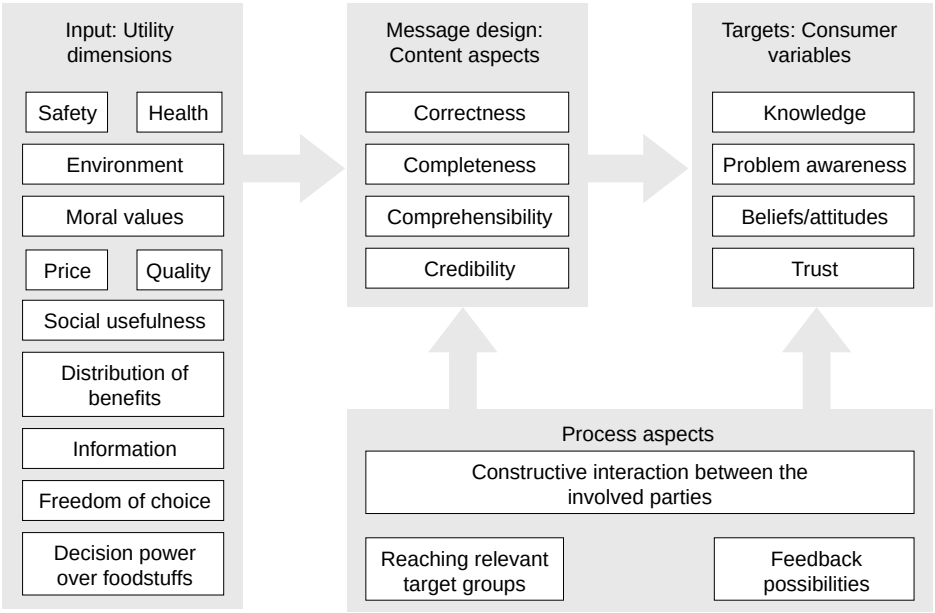
The first group refers to the actual *content* of the message: substantive correctness and completeness of information, comprehensibility of the message, congruence between message and information needs in the target audience, belief/ trust the in given information, attention-calling ability, and ethical considerations. The second group of criteria deals with the effectiveness of the communication *process:* difficulties and failures in running the program, inclusion of relevant actors and social groups, feedback possibilities, facilitation of communication, constructive interaction between the involved parties, and reaching relevant target groups. The third group refers to the *outcomes* of the communication process: degree of information dissemination, reception of the information provided, increased knowledge, advanced problem awareness and involvement, consistency and homogeneity of responses to the message, acceptance of the message, confidence in the information source, change in beliefs and attitudes, improved risk-controlling behaviour, amount of participatory activities, number of responses to the risk communication agency, reduction of accident/ illness/mortality rates, and, finally, conflict resolution.

Not all of these criteria can be assessed by means of an expert survey. As Rohrmann (1992) indicates, criteria like congruence between message and information need, or acceptance of the message, have to be assessed by the target audience. In our case, this would require a consumer survey (see Bredahl, Grunert & Frewer, 1998, for a review of recent research). Moreover, not all of these criteria can be applied to genetically engineered food products. Reduction of mortality rates or improved risk-controlling behaviour, for example, clearly pertain to issues like toxic substances or accident-prone driving and are not relevant for the present study.

Twelve of the criteria will be maintained in our study. *Content aspects* will include substantive correctness of information, completeness of information, relevance and utility of information, comprehensibility of the message, and credibility of the information source. *Process aspects* will include constructive interaction between the involved parties, reaching relevant target groups, feedback possibilities and dialogue with the consumer. *Outcome aspects* will include increased knowledge, problem awareness and involvement, positive evaluation/ attitude change/reduction in perceived risk, and, finally, increased credibility and trust in the information source.

All this may be integrated into a risk communication model (Figure 3). The utility dimensions from Smink and Hamstra (1994) enter as the input of the model, providing the information database to the communication programme. This "raw input" undergoes a process of message design, in which the content aspects correctness, completeness, and comprehensibility are edited and adapted to the credibility of the respective actor. Input and message design interact with the process aspects, specifying how effectively the message is implemented. All of these independent variables aim, of course, at certain targets, that is, at the respective consumer variables that are to be affected (knowledge, awareness, attitude, or trust).

Figure 3. A risk communication model for genetically engineered food products (cf. Smink & Hamstra, 1994; Rohrmann, 1992)



Aim of the study

As discussed above, Smink and Hamstra (1994) have extensively reviewed the risks and benefits of genetically engineered food products. However, several years have passed since their report was published. Moreover, none of their studies provide a detailed account of risk communication strategies. Consequently, the objectives of our study are

- to gain an understanding of the consumer-relevant risks and benefits of genetically engineered food products, and

- to survey risk communication programs that have already been implemented, programs that are currently planned, and possible alternative ones, as they are perceived and discussed by the European expert community in late 1997.

The empirical part of the paper will present the results of four expert focus groups we have conducted in Denmark, Germany, Italy, and the United Kingdom in November 1997. Leading European experts were invited to discuss the risks and benefits, as well as the risk communication strategies planned by their organisations.

Based on Smink and Hamstra's (1994) classification of risks and benefits, and Rohrmann's (1992) criteria for evaluating risk communication, a category system was developed that will serve as a prestructuring frame for the in-depth analyses to follow. The qualitative analyses will be presented category-wise, identifying and contrasting the strategies elicited from the respective actors.

METHOD

Focus groups are a common tool in market research. The main guidelines and procedures appeared for the first time in a seminal paper by Merton, Fiske, and Kendall (1956). The technique has been widely applied to various fields like product development and positioning, habits and usage studies, and attitude research.

The rationale behind the method is to utilise group interaction in order to elicit the maximum non-redundant information about a given set of topics within a reasonably short period of time. Morgan and Krueger (1993) identify special advantages in cases where the degree of consensus on a topic is to be investigated, where a gap between professionals and their target audiences exists, and where a research method is needed that is respectful and not condescending to the target audience.

A regular focus group consists of a discussion involving up to twelve persons, led by a trained moderator. As a group technique, however, focus groups are subject to the usual biases known from small group research: leadership, conformity, groupthink, and polarisation of attitudes. Elaborate moderating techniques (Greenbaum, 1993) and detailed discussion guidelines help minimise bias.

Table 2. Composition of the expert focus groups

Actor	Denmark	Germany	Italy	United Kingdom	N
Scientific research institute (SCI)	SCI-DK-1 SCI-DK-2	SCI-D-1 SCI-D-2 SCI-D-3	SCI-I-1 SCI-I-2 SCI-I-3 SCI-I-4	SCI-UK-1 SCI-UK-2	11
Authority responsible for approval (AUT)	AUT-DK-1	AUT-D-1		AUT-UK-1	3
Supplier of genetically modified organisms (GEN)	GEN-DK-1	GEN-D-1 GEN-D-2	GEN-I-1 GEN-I-2 GEN-I-3 GEN-I-4	GEN-UK-1 GEN-UK-2	9
Food processing industry (FOO)	FOO-DK-1	FOO-D-1			2
Association of Industry (IND)	IND-DK-1	IND-D-1 IND-D-2		IND-UK-1	4
Agricultural organisation (AGR)	AGR-DK-1			AGR-UK-1	2
Retail (RET)	RET-DK-1	RET-D-1	RET-I-1		3
Media (MED)		MED-D-1	MED-I-1 MED-I-2	MED-UK-1	4
Communication agency (COM)		COM-D-1	COM-I-1		2
Consumer organisation (CON)	CON-DK-1	CON-D-1	CON-I-1	CON-UK-1	4
Environmental organisation (ENV)	ENV-DK-1	ENV-D-1	ENV-I-1	ENV-UK-1	4
N	10	14	14	10	48

Participants and design

In autumn 1997, the four participating research institutions in Denmark, Germany, Italy, and the United Kingdom recruited outstanding experts for participation in the focus group discussions. Reflecting the different actors involved, we attempted to ensure that at least one representative of each of the following groups would take part: scientific research (SCI), authorities responsible for the

approval of genetically modified organisms (AUT), suppliers of genetically modified organisms (GEN), food processing industry (FOO), associations of industry (IND), agricultural organisations (AGR), retail (RET), media (MED), professional communication agencies (COM), consumer organisations (CON), and environmental organisations (ENV). The final composition of the four focus groups is given in Table 2, together with the participant codes that will be used in the results section. Altogether, N = 48 experts participated in the study.

Procedure

At the beginning of the focus group discussions, the moderator introduced him or herself to the participants, gave a brief outline of the objectives of CADE-GENTECH, and a short characterisation of her respective research institution. S/he briefly explained the purpose of the focus group session, the schedule to be followed, drew the participants' attention to the video cameras that were recording the session, asked for permission, and assured confidential treatment of the participants' identity. The warm-up topic elicited the different views on global trends in the food sector which might evolve from the increasing use of genetic engineering methods, including perceived change in consumer characteristics and nutritional habits. Beginning /hisher first statement, the respective participant shortly introduced him/herself and his/her institution.

The first main part of the discussion identified the outstanding risks and benefits of genetic engineering in food production as they appeared to the various actors involved. The moderator prompted the coverage of eleven content aspects (see Table 1): safety, health, environment, moral values, price, quality, social usefulness, distribution of benefits, information, freedom of choice, and decision power over foodstuffs. After risks and benefits had been extensively discussed, each participant was asked to state the three topics he or she expected the public debate to focus on in the future.

The second part focused on risk communication, including the demand for strategic action as viewed by the experts, perceived consumer characteristics and demand for information, responsibility for and willingness to provide information (via labelling or alternative channels), and, finally, risk communication strategies. Details were welcome, especially those concerning the intended outcomes of communication strategies (eg, establishing consumer knowledge, positive evaluation, or trust in the producer), and the means by which these goals were to be attained (eg, stressing the advantages of genetic engineering methods, or discounting the risks associated with their use).

The discussions concluded with a few remarks by the moderator. A short summary was given, together with acknowledgements, hope for future co-operation, and an outline of the subsequent steps to be carried out in the project.

Data analysis

A content analysis procedure similar to Knodel (1993) was chosen. In a first step, the video-taped discussions were transcribed, translated, and divided into meaningful segments. Altogether, the resulting verbal material consisted of 787

relevant segments, of which 138 (17.5 per cent) were extracted from the Danish, 288 (36.5 per cent) from the German, 99 (12.6 per cent) from the Italian, and 262 (33.3 per cent) from the English focus group data. In a second step, the data segments were classified according to the category system presented in Table 3 and Table 4. The categories were defined as mutually exclusive, that is, each statement was assigned to only one category. In a third step, the data in each category were paraphrased and grouped according to equivalent content. It must be noted, however, that such a procedure requires a considerable amount of judgement and, consequently, also a certain degree of subjectivity. But remember that this is a qualitative study, a study where it is more important to find the right questions than the exact answers.

Table 3. Category system for risks and benefits (cf. Smink & Hamstra, 1994)

Category	**Code**	**Sample statement**
Safety	1	There is indeed a certain risk of foreign genes transferring from the g.m. plant to wild corn species, but it is rather low.
Health	2	Genes expressing allergenic protein synthesis have been removed from rice.
Environment	3	Roundup is perfectly appropriate for sustainable development due to its degradability by rhizospheric micro-organisms.
Moral values	4	We have the obligation to preserve creation, so genetic modification of living organisms cannot be acceptable.
Price	5	Increments in production efficiency will foster better price-performance ratios.
Quality	6	Our company has developed starter cultures that help meat products be stored much longer.
Social usefulness	7	Society has survived without genetic engineering for thousands of years, so what is the actual use of these methods?
Distribution of benefits	8	Again, only the large companies will profit from their patents, and the farmer has to pay for them.
Information	9	We note any ingredient derived from Roundup Ready soybeans on the label, regardless of what the novel food directive says.
Freedom of choice	10	Information will be given on the label, so that the consumer may decide if she is going to purchase traditionally produced yoghurt or novel food.
Decision power over foodstuffs	11	The consumers have never been asked if they wanted biotechnology to provide gene tically engineered products, or if not.
Miscellaneous	12	

Table 4. Category system for risk communication (cf. Rohrmann, 1992)

Category	Code	Sample statement
Content aspects		
Substantive correctness of information	13	It is very difficult to counteract emotional reporting and purposely false information with scientific facts.
Completeness of information	14	Information campaigns have to provide the consumer with the same amount of information that is available to the experts.
Relevance and utility of information	15	We may compare industry products with organic products: Do you really get any usable information from the label "organic"? It does not give any product information.
Comprehensibility of message	16	Although different sets of scientific and technical terms are intended to communicate the same content, their incongruency may appear as a mere information mess to the public.
Credibility of the information source	17	There are several studies that investigated consumers' trust in information depending on the field of application: trust is strong in the medical domain but very weak in other domains.
Process aspects		
Constructive interaction between the involved parties	18	The public debate on genetic engineering may be described as being subject to some kind of task distribution. The role of consumer organisations is then to point at potential risks and ask if the notions presented as facts are really facts or not.
Reaching relevant target groups	19	The breeding industry has to target the so-called gate keepers as well as the actual consumers, especially the retailers as a sort of interface between producers and consumers.
Feedback possibilities and dialogue with the consumer	20	Product information may be given via product testing in retail shops, where in-house personnel is available for further product consulting.
Outcome aspects		
Increased knowledge	21	Our information policy shall include clarification of the whole course of product development before actual market entry, that is, scientific testing and risk assessment, so that we can at least put up with elementary customer uncertainty.
Problem awareness and involvement	22	Consumers do not regularly re-evaluate the list of ingredients on the product label, so that a change in the product composition will not be detected and will not influence consumer behaviour.
Positive evaluation, attitude change, and reduction in perceived risk	23	Resistance to genetic engineering is mainly driven by emotional factors, and emotional factors have to be taken into account to establish more positive evaluation of products.
Increased credibility and trust in the information source	24	Most environmental organisations are considered trustworthy by the public. But I fear that we will lose our trustworthiness if we do not learn to adjust our positions to new evidence.
Miscellaneous	25	

RESULTS

The following section will present the key results of the four expert focus groups held in Denmark, Germany, Italy, and the United Kingdom. Throughout the section, the experts will be identified by the codes given in Table 2. Full confidentiality was assured, no names or affiliations will be given. It should be noted that the participants' views do not necessarily reflect the official positions held by their organisations.

Risks and benefits

The first part of the analyses will be organised around the consumer utility dimensions from Smink and Hamstra (1994): safety, health, environment, moral values, price, quality, social usefulness, distribution of benefits, information, freedom of choice, and decision power over foodstuffs.

Safety

The perhaps most astonishing result of the study was the experts' general unwillingness to resume the public debate on safety risks and benefits. Although some general reservations were reiterated, for example potential misuse (AGR-UK-1, AUT-UK-1, GEN-UK-2) and unpredictability of evolutionary consequences (CON-D-1, ENV-UK-1, MED-UK-1, SCI-UK-1, AGR-UK-1), no specific positive or negative claims according to food safety were presented. The German experts agreed even collectively that the risk discussion was over. As the representative of a Danish environmental organisation put it,

> *We have passed the monster theory that we cannot control genetically modified organisms and that something will eventually go wrong* (ENV-DK-1).

However, the end of the risk discussion was interpreted in different ways: That the safety requirements and administrative procedures may simply be perceived as appropriate (AUT-D-1), that the critics have not been able to present scientific evidence for their risk theories (GEN-D-1), and that global assessments of the risks and benefits of a production technique as a whole are pointless, because only the actual behaviour of a specific organism can be judged meaningfully (COM-I-1, MED-I-2). Besides, the pro side wondered what was so special about genetic engineering (FOO-DK-1, COM-I-1, MED-I-2), maintaining that it was competitively unfair to impose the strong safety requirements only on genetic engineering techniques and not on other methods in breeding and food processing (SCI-DK-1, SCI-DK-2, AGR-DK-1). This view was partially shared by the sceptics:

> *There are two possible ways of dealing with the problem that genetically engineered food products are subject to control while conventionally produced products are not. Either we should not have any control of products made with the aid of gene technology, or we can say that we should have control procedures for all products, whether produced by conventional methods or not. I agree with the latter view* (CON-DK-1).

Assuring that products do not contain genetically modified components is often impossible for producers and retailers, especially when raw materials or products are imported from outside the European Union (IND-D-1, IND-D-2). Only specific branches of the food industry, for example baby food, will under great expenditures be able to assure that their products do not contain genetically modified components (IND-D-2).

Health

In the past, health issues have perhaps been the most extensively discussed public concern related to genetically engineered food products. Especially German experts perceived a general consumer trend to healthy food (ENV-D-1, SCI-D-2), but questioned whether substantially improved health products would enter the European market within the next five years (GEN-D-1, SCI-I-4, AGR-UK-1). Table 5 gives an overview of the more specific health risks and benefits raised during the focus group discussions.

Table 5. Specific health risks and benefits

Risks	**Benefits**
Antibiotic resistance (SCI-I-2, ENV-I-1)	Anti-cancerogenic products (AUT-UK-1, SCI-UK-2)
Allergies (IND-DK-1, SCI-DK-2, AGR-UK-1, IND-UK-1, GEN-UK-2)	Reduced lactose products (COM-D-1)
	Low cholesterol products (ENV-D-1)
	Ready-to-use diagnostics for detecting nutritional deficiencies (SCI-D-2)
	Slower going off (GEN-DK-1)

On the other hand, it was objected that the potential health benefits gained from genetically engineered food products would hardly be easier to communicate than the health benefits gained from conventional products (CON-D-1), that healthy food could equally well be produced without genetic engineering (ENV-D-1), and that public health issues were generally exaggerated in the industrialised countries (ENV-UK-1, MED-UK-1) and should not be additionally linked to possible gains from novel food products:

> *I wonder if the scientists don't sometimes fall into these traps too of wonky estimations of risks. I mean the GM foods that are meant to reduce our risks of cancer. Surely it is better to give up smoking* (MED-UK-1).

However, there were cross-national differences. Whereas British participants claimed that health issues were overdone, consumer health maintenance in Italy seems not even to work properly with conventionally produced foodstuffs (ENV-I-1, SCI-I-2).

Environment

The outstanding environmental risk that was related to transgenic organisms was the possibility of an unintended gene transfer into wild populations (AUT-DK-1, ENV-I-1, AGR-UK-1, AUT-UK-1, CON-UK-1, ENV-UK-1, GEN-UK-2). Besides, only general claims of threatened sustainability were made (MED-D-1, SCI-UK-1). These objections were countered by a rather unexpected point, namely that transgenic plants may increase the genetic variety in cultivated areas, thus decreasing the risks arising from monocultures (AGR-DK-1, SCI-DK-1, AUT-UK-1).

Sustainability was also called upon from the benefit side: herbicide resistant plants provide environmentally sound agricultural production and food processing (IND-D-2, GEN-DK-1, GEN-UK-2), especially through an up to 40% reduction in herbicide expenditures (GEN-D-2, GEN-I-3), reduced energy consumption (IND-DK-1), and reduced transportation costs (SCI-DK-1) due to more independence of environmental constraints (IND-D-2, COM-I-1, SCI-I-2, GEN-I-3, AGR-UK-1).

Moral Values

The notion of sustainability was, however, not only confined to the more or less scientific question about impacts on the environment. Sustainability has also strong moral dimensions (MED-D-1, CON-DK-1, SCI-DK-2):

> *The discussion for or against genetic engineering is really about which kind of growth we want to have in our society, and which values we want to promote. At present the food industry and primary production are geared to high production rates and low production costs, and this conflicts with other people's demands for better quality and slower, decentralised production. There is a dilemma between two different sets of values... Today's highly centralised and efficient food production results in a quality loss, which is perceived by the consumers. Genetic engineering is then used to re-establish the consumers' perception of quality while at same time retaining the existing production structure. What is really being criticised in the public debate at the moment is actually the very consequences of the existing production structure in terms of increased transport costs, non-transparency, standardisation, and unethical production methods. People oppose the present applications of genetic engineering because they are not in line with the social values which are dominating in the Western World at the moment. Genetic engineering has simply become a whipping boy* (CON-DK-1).

Closely linked to this is the view of genetic engineering as interfering with nature, an attitude that several experts perceived as being widespread in the general public (AUT-DK-1, AGR-UK-1, AUT-UK-1, SCI-UK-2, IND-UK-1). Depending on the respective position, objections of this kind were discounted either as being logically faulty since no cultivation is 'natural' in such a sense (SCI-UK-1), as masking simple resistance to technological innovation (AUT-UK-1, IND-UK-1), or as being just a matter of appraisal (ENV-UK-1). Moreover, several participants thought that the ethical debates about genetic engineering were far too general to provide any consumer-relevant issues specific for a given product,

thus rather obscuring than clarifying the ethical dimensions of genetically engineered food products (GEN-UK-1, GEN-UK-2, IND-UK-1, MED-UK-1).

Apart from general ethics and sustainability, the notion of animal welfare received considerable attention. As could be expected, a certain digression exists: on the one hand, micro-organisms provide an alternative to enzyme extraction from, for example, calves:

> *Animal-lovers say that it is completely irresponsible in terms of animal welfare to slaughter 270,000 calves in this country every year to produce rennet, when it can be produced by means of genetic engineering, and the technology can even produce entirely clean enzymes. So, interestingly, animal welfare can here be used as an argument for the use of genetic engineering in food production* (AGR-DK-1).

Another application providing positive effects on animal welfare is the silencing of genes expressing horngrowing in cows, thus reducing the danger of serious injuries in large-scale cow breeding (COM-D-1). On the other hand, many experts feared that European consumers would be even more critical about transgenic animals than about transgenic plants (COM-D-1, IND-UK-1, AGR-UK-1, GEN-UK-1), although reservations are generally less strong when the application is clinical, for example in cows producing allergy-friendly milk (SCI-DK-2).

Price

As all of the experts agreed, price advantages are the outstanding asset of genetically engineered food products. In the first place, farmers realise cost advantages due to reduced pesticide expenditure (AGR-DK-1). Herbicide resistant rape, for instance, has gained a market share of about thirty per cent within three years after market introduction (GEN-D-1). Herbicide resistant soybean seeds are currently even subject to excess demand (GEN-D-1). It is assumed that decreases in the price of raw materials will carry over to subsequent stages of the production chain and finally enhance the price-performance ratio of consumer goods (GEN-D-1, AGR-DK-1).

The notion of cost advantages has some further implications: pesticide resistance in crops provides competitive advantages for those producers who have decided to grow genetically modified seeds. Naturally, this brings its competitive disadvantages for those producers who have decided to keep on growing conventionally bred seeds (GEN-I-1), and this holds for competition within the European Union as well as for competition with the US industry and other major suppliers of the world market. So if no stronger market barriers will be put up, the European food industry may not have a real choice regarding the growing and processing of transgenic plants (SCI-I-3).

Quality

According to the expert audience studied, the development of genetically engineered food products seems to follow some sort of ‘generation pattern’. Most products that have already entered the European market are perceived as a

first generation whose quality attributes pertain to improved cultivation, processing, and distribution characteristics (GEN-D-1, ENV-DK-1, FOO-DK-1). Significant changes in functional characteristics will require considerably more time, and many experts did not expect them before 2010 (GEN-D-1, IND-D-2, RET-D-1, SCI-D-2).

Changes in functional characteristics that are currently under development include allergy-friendly breastmilk substitutes (AUT-DK-1, IND-DK-1, FOO-DK-1), soybeans with modified oil composition (GEN-D-2), potatoes with modified starch composition (GEN-D-2), and products containing less saturated fatty acids (MED-UK-1), resulting in improved nutritional value and thus providing healthiness as a quality attribute (SCI-I-2, COM-I-1, SCI-UK-1, SCI-UK-2, GEN-UK-2).

However, several experts stressed that the effects of improved quality on product sales are most likely subject to price constraints (ENV-D-1, AGR-UK-1, SCI-UK-1). That is, demand for genetically engineered food products will only increase when their quality is superior while their price remains constant or is lower than that of conventional products.

Social usefulness

Product and market characteristics evaluated as 'socially useful' centred around three major issues: health, freedom of choice, and progress/development. Regarding the health issue, European consumers seem to perceive healthy food as a medical application (AGR-DK-1), providing benefits that could not be achieved in other ways (GEN-D-1), and thus being an acceptable public health measure.

Concerning the freedom of choice issue, genetically engineered food products add to the current level of product differentiation and provide further possibilities of choice (GEN-D-1), perhaps even new markets for entirely new product qualities (GEN-I-1, CON-I-1). As one participant mentioned, this also includes the opportunity to choose between different kinds of production:

> *There is a growing potential of choice over production techniques, including so-called 'organic' ones which also include the use of several pesticides. This potential shall be retained, but also enlarged by greater product differentiation, and the consumers will take this into consideration* (GEN-D-1).

A well-known point regularly made by the proponent side is the more reliable cultivation of genetically modified crops in the developing countries, offering the chance to reduce starvation and propagate development (GEN-DK-1, GEN-I-1, CON-I-1). The People's Republic of China has declared a public goal to match the Western countries in research about genetic engineering by the year 2005 (GEN-DK-1).

However, the notion of progress seems also of relevance to the developed world. Since the western societies are used to continuous improvements in average quality of life, it should also be a matter of social concern to maintain the slope of development, and biotechnology is one of the key factors in technological innovation (CON-UK-1, IND-UK-1). Without further innovation, the western

societies might lose their leading standards of welfare (GEN-UK-2), a scenario that clearly questions the rationality of the public debate on genetic engineering (FOO-DK-1, CON-UK-1, IND-UK-1).

Distribution of benefits

However, social usefulness is a highly aggregate construct. Judgements of general social usefulness require further qualification by the distribution of benefits among the involved actors, that is: who actually gains from the introduction of genetic engineering techniques to agriculture and food processing?

Apart from very few exceptions (eg, the well-known Flavr Savr™ tomato; SCI-UK-1, SCI-UK-2), the current generation of genetically modified food products focuses its benefits on the producer side (ENV-DK-1, CON-D-1, ENV-D-1, AUT-UK-1). Producers may gain competitive advantages through more effective use of agriculturally productive land (GEN-D-1, IND-D-2, GEN-I-4, SCI-I-3), through improved logistics due to enhanced storage and transportation qualities (FOO-DK-1), and through optimal use of processing capacities (IND-D-2).

Such attributes are indeed difficult to communicate (CON-D-1). Apart from cost advantages transferred along the production chain, or claims of environmental friendliness (CON-DK-1, GEN-D-1; see also above), it was generally agreed that European consumers demand improvements in the actual quality characteristics of products (AUT-DK-1, ENV-DK-1, FOO-DK-1, IND-DK-1, SCI-DK-2, GEN-D-1, AGR-UK-1, AUT-UK-1, CON-UK-1, IND-UK-1, MED-UK-1, SCI-UK-1, SCI-UK-2; see also above).

Information

Although information and transparency are generally regarded as important features of a democratic public, there may sometimes be a risk in information itself. The point is well captured by the following quote from the English focus group discussion, clarifying what was really meant by the term 'social amplification of risk' (Kasperson et al., 1988):

> *I think it is sensitisation because there is much more information about food safety now, and something that happens very, very infrequently in the whole of a very complex and enormous food chain is instantly big news whereas 50 years ago it would have been insignificant as there were much greater hazards around and what we have done is just peeled back our levels of awareness so now we are very sensitised. The slightest thing goes wrong and we are greatly aware of it and what may seem catastrophic now would have been almost lost 50 years ago against the background of other problems* (GEN-UK-2).

However, the problem of sensitisation also extends to the labelling of genetically modified food ingredients: consumers may misinterpret notes on the package label in such a way that labelled ingredients are automatically misperceived as risky ingredients (AUT-D-1, MED-I-1, IND-UK-1). Clearly, this is not what was initially intended by the labelling discussion. Responsibility was quickly blamed

on the usual suspects: environmental and consumer organisations having established a stable counterfactual association between genetic engineering and risk (COM-I-1, AUT-UK-1), and the media readily picking up such counterfactual messages and even multiplying them (AGR-DK-1, SCI-DK-2).

Freedom of choice

Freedom of choice is a fundamental property of non-monopolistic economies as well as a fundamental right in open societies. In this sense, the purpose behind labelling of genetically engineered food products is, of course, to enable informed consumer choice (CON-D-1, ENV-D-1, AUT-DK-1, ENV-I-1, GEN-I-3, GEN-I-4, CON-UK-1, GEN-UK-2). While several proponents argued that genetically engineered food products provide more variety in food markets and thus by definition improve consumer choice (GEN-I-1, MED-I-2, RET-I-1, SCI-I-1, ENV-UK-1, GEN-UK-2, IND-UK-1, SCI-UK-1), others were not so unconditionally optimistic.

It was doubted if a choice between genetically modified products and unmodified products would even be possible: soybeans, for example, are not distributed separately on the world market, so that no producer or retailer can guarantee that his input material has definitely been free of genetically modified varieties (RET-D-1). Consequently, virtually any traded product may contain traces of genetically modified material (RET-D-1, AGR-UK-1, CON-UK-1, ENV-UK-1, GEN-UK-2, IND-UK-1, SCI-UK-2). One participant even predicted that consumers would only face a decision between products that are labelled and products that are not labelled, which is obviously something different than a decision between products that are genetically modified and products that are unmodified (RET-D-1).

Furthermore, informed choice requires a certain amount of knowledge (IND-UK-1, MED-UK-1). Knowledge, however, may be formed upon information that is unbalanced or even deliberately biased, resulting in faulty judgements and, finally, in faulty decisions (CON-UK-1, ENV-UK-1).

Decision power over foodstuffs

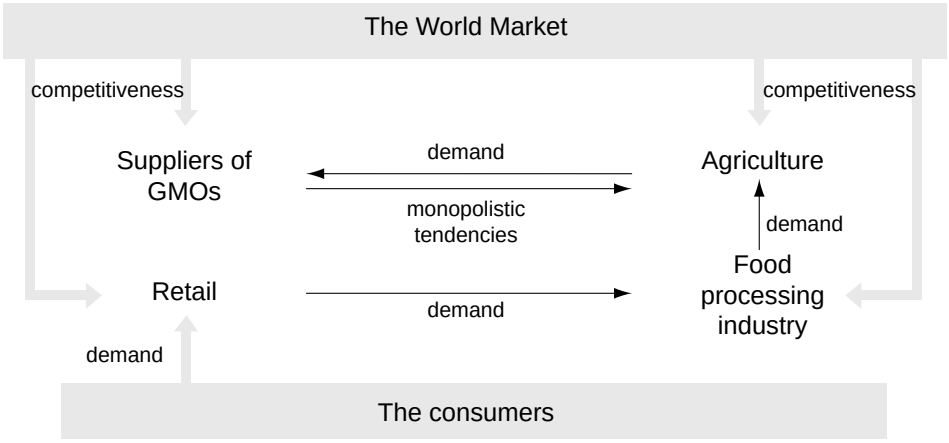
The question of who actually controls the development of the food sector is both a descriptive and a normative one. As expected, the perceptions of actual control varied wildly. The food processing industry participants, for example, felt that there was no possibility of controlling the raw materials they used (FOO-DK-1), especially when the materials were imported (GEN-DK-1, IND-DK-1), whereas other actors maintained that exactly the food processing industry had the power to control primary production (AUT-DK-1, RET-DK-1):

> *Food producers can control the primary production by the products they demand and buy, so they can actually avoid genetically engineered ingredients if they wish so. It is the consumers who do not have a choice. But, of course, it will become more expensive to buy non-genetically engineered raw materials (AUT-DK-1).*

In a similar way, control was assigned to the retailers (GEN-UK-2, MED-UK-1, SCI-UK-1), while others perceived just the opposite (SCI-D-3). The consumers

were also referred to as the primary demand side factor, ruling the food market by means of purchase and boycott (SCI-I-3), while others perceived them as largely powerless (CON-D-1, COM-D-1, AUT-DK-1, CON-DK-1, RET-DK-1, SCI-DK-2). Furthermore, monopolistic tendencies (CON-DK-1, SCI-DK-2, GEN-UK-1) and the overwhelming influence of the US market (IND-DK-1, SCI-DK-1, SCI-UK-1) were blamed. The general structure of these control attributions is best depicted graphically. Figure 4 shows that, in the subsequent markets constituting the food chain, the respective actors systematically blame the actors in the *predecessing* market.

Figure 4. Perceived control structures in the food chain. Arrows indicate control attributions made by the participating experts



Altogether, this suggests some kind of 'passing the buck' rather than a reasonable analysis of market processes, even when only longitudinal studies including multiple market factors may finally show who has been right. Nonetheless, attributions of control will strongly affect the strategies chosen to communicate the risks and benefits to the public.

Risk communication: Content aspects

So far, we have only discussed the risks and benefits of genetically engineered food products. According to our model, they provide the input information to the actual risk communication process. In a first step, the raw information undergoes a process of message design, in which the correctness, completeness, and comprehensibility of the content aspects are edited and adapted to the credibility of the respective actor.

Substantive correctness of information

The first criterion for effective risk communication is the substantive correctness of the information. Apart from questions of detail and simplification, there sometimes seems to be a problem of at least inadvertent misrepresentation of scientific information by the media (AUT-UK-1, CON-UK-1, GEN-UK-2, IND-UK-1,

SCI-UK-1). A worrying example is the confusing of genetic engineering with actually unrelated horror scenarios like BSE, as reported by a British scientist:

> *There is also an element of things having gone wrong with. I mean frequently people bring BSE up in connection with GM foods. I have had a reporter asking a double barrelled question you know, 'what about BSE and now GM food' and I was supposed to answer this. I spent ten minutes unravelling the question before I could answer them* (SCI-UK-1).

The misrepresentation of scientific information in commercial contexts was perceived as more deliberate. The inherent uncertainty of statistical estimates, for example, offers many opportunities of creative re-interpretation (ENV-D-1, AGR-UK-1, GEN-UK-2): reporting only the lower or upper bounds of confidence intervals, confusing measures of absolute and relative risk, or failing to take sample size and statistical power into consideration, can be used to transform vague probabilistic statements into expressions of utmost certainty.

Paradoxically, food industry and retailers may sometimes stand in the way of themselves. This is particularly the case when genetically engineered food products are interpreted in the context of the entire product range offered by a company: advertising strategies often draw counterfactual images of food production, trying to induce stable associations with tradition and naturalness. There is, however, a pronounced contrast between such images and the images generated by high-tech methods like genetic engineering (COM-D-1, SCI-D-3), a contrast showing either genetically engineered food products or the marketing of conventional food products in a rather bad light.

It must be added that certain non-governmental organisations also tend to dishonesty when confronted with scientific evidence that could weaken their position (AUT-D-1, ENV-D-1, GEN-D-1, IND-D-2). Amazingly, this was even admitted by the representative of a large German environmental group:

> *It is often the case that we excessively discuss issues far from any importance in order to make up a risk which is actually fundamental bullshit. On the one hand, there is a risk in differentiating too much: if you judge each single case separately, you will come to a point where you lose the global view and suddenly find yourself with an entirely positive attitude towards genetic engineering, having forgotten all about the risks. On the other hand, non-governmental organisations do not really allow concessions. For example, the vitamin-A rice project is in my opinion a quite valuable project, but I am not allowed to acknowledge positive aspects in the public because such a view is not in line with the fundamentally rejective position held by my organisation* (ENV-D-1).

We cannot judge to what extent the statement can be generalised, but in any case it casts doubt if certain environmental groups are prepared to participate in a public dialogue. Dialogue would require a basic readiness to adjust fundamental positions, but such a readiness can currently not be seen in most groups (ENV-D-1).

Completeness of information

The amount of information about the development and market diffusion of genetically modified organisms has been limited in the past years. Even if these constraints were partially due to patent law, several experts felt that the amount of information was so limited that genetic engineering made almost the impression of a little conspiracy (AGR-DK-1, AUT-DK-1, ENV-DK-1, CON-D-1, GEN-D-2, MED-D-1, SCI-I-1, SCI-I-2). But as the representative of a leading supplier of genetically modified organisms explained, their strategy did not prove very effective:

> *Our [company name] information policy was to start communicating the whole issue only after decision pressure had become urgent. From that negative experience, we [company name] have decided to provide a more steady information flow* (GEN-D-2).

However, there is a digression on the exact amount of information that is to be provided to the consumer. Although some participants from the proponent side maintained that the novel food directive was already a major step towards more openness (AUT-DK-1, FOO-DK-1, RET-DK-1), other statements were more critical and demanded that reasonable product information should go well beyond a short label on the package (CON-D-1, MED-D-1), for example by giving a full list of the ingredients and explaining the functional differences of those ingredients that are genetically modified. Furthermore, consumers also demand information about the production methods involved (AUT-DK-1, FOO-DK-1). Ignoring such needs might result in extremely critical attitudes, comparable to those many consumers hold towards large-scale meat production:

> *Consumers want to be informed about the technology that has been applied, just like they want to be informed about whether eggs are from free-range or battery hens, because they wish to influence production methods* (AUT-DK-1).

Several experts felt even obliged to provide the consumer with the same amount of information that is available to experts (RET-D-1), including not only basic knowledge on genetic engineering, but also the necessary skills for interpreting scientific data: the rationale of risk assessment, a balanced discussion of risks and benefits (RET-D-1, SCI-D-2, CON-UK-1, ENV-UK-1, SCI-UK-2), comparisons with other methods in food production (RET-DK-1), and the administrative procedures preceding the actual marketing of genetically modified organisms (SCI-D-2, SCI-D-3):

Public information should not only include the usual reiteration of scientific facts but also an explanation of the way in which certain decisions are made. Consider the example of introducing a new product: it would be preferable if consumers didn't have the image of a mad scientist in mind whose company would push products of unknown quality and health characteristics into the market as soon as they seem to yield profit. Public information should also include quality control, standards of safety, regulative and administrative procedures so that the whole course of product development is more transparent (SCI-D-3).

Only few experts objected that such an enormous supply of information might expect too much of the consumers. Even when the underlying motive was more

transparency and fairness, an excess of information might rather create overload, confusion, and even reaction (COM-I-1). To avoid this, it was proposed that scientific information should better be reduced to an almost dishonest degree of simplicity. Otherwise, there would simply be no audience who would listen (GEN-D-2).

Relevance and utility of information

While the problem of overload results from too much information, we may also ask if the given information is at all relevant for consumer choice. Is there some kind of 'objective utility' in, for instance, the labelling of certain food additives? The most obvious example is the case of the soybean. Numerous products contain additives derived from soybeans, but only very few products do actually contain soybean DNA or the specific protein controlled by the modified gene.

Several experts indicated that a label like 'may contain traces of genetically modified soybeans' would neither be discriminative (because so many products contain additives derived from soybeans) nor substantial (because they contain no DNA). Instead, labelling would only be reasonable when there were functional differences (AUT-D-1, GEN-D-1, COM-I-1). For similar reasons, labelling of the very absence of genetically modified ingredients was not approved of. A possible compromise was sketched by the representative of a Danish agricultural organisation:

> *Negative labelling like 'guaranteed free of genetic engineering' is a bad idea. It expresses a negative attitude towards this production technology. Labels like 'may contain genetically engineered material' or labelling of the technology is much more neutral, but also implies that quite many products will have to be labelled. It is simply unrealistic to expect companies to subject all soybeans which they buy to DNA tests. It is too expensive and too time-consuming. Therefore, I advocate that labelling should only be compulsory by a limit of far more than two per cent remains of genetically engineered material in a food product* (AGR-DK-1).

Others even denied that information on the production technology had any relevance at all (GEN-D-1, MED-D-1, RET-D-1, IND-DK-1, RET-DK-1, GEN-I-2). It should at least be disentangled from information on the product ingredients (SCI-D-3). Product ingredients, in turn, are not necessarily informative when listed as such: A consumer also has to be able to interpret the product information correctly, that is, what the exact functional differences are and what their effect on the nutritional value of the product is (RET-D-1).

Comprehensibility of the message

Information can only have the intended effect when it is correctly understood by the consumers. However, this may result in a dilemma: on the one hand, information has to be readily conceivable. On the other hand, it has to be substantially correct, exact, and in line with generally accepted standards and law (GEN-D-2). As a first step towards a better public understanding of scientific information, many experts demanded thorough improvements on the language used. Information should be clear-cut and unambiguous, avoid jargon, and use

the same terms whenever the same subject is discussed (CON-D-1, GEN-D-2, RET-D-1, SCI-D-2, RET-DK-1, ENV-I-1, RET-I-1, AUT-UK-1).

Consumer understanding of label expressions seems to be faulty. The label 'made with the help of modern biotechnology' is often associated with organic food (ENV-D-1), and acronyms like 'GMO' or 'GE' are not generally known either (ENV-UK-1). Some of the critics thought that such expressions were used deliberately (ENV-D-1, AGR-UK-1, ENV-UK-1, SCI-UK-2), trying to hide important facts behind incomprehensible, hollow words. While also at risk of being misunderstood, the advocates of voluntary labelling had however different fears:

> *Those parts of the industry which are open to voluntary labelling still face several difficulties, especially because it is possible that the consumers may misinterpret the difference between products that are actually genetically modified and products that are not modified themselves but may contain substances which have been in contact with genetic engineering* (FOO-D-1).

Moreover, the complexity of the given information should be carefully matched to existing knowledge and information processing capacities in consumers, avoiding both oversimplification and excessive demand (GEN-D-2, SCI-D-2, SCI-D-3, ENV-DK-1, SCI-DK-2). Especially critical is the communication of statistical figures:

> *The Institute of Grocery Distribution survey showed what the consumers want, it was quite clear. They don't want it to be too complicated. They don't want percentages, they don't want 10.2, they don't understand it. Most people don't understand what percentages are. They want very simple, basic information* (AGR-UK-1).

Amazingly few of the participating experts saw this as a problem. Recall that some even proposed a full-information approach to risk communication, including scientific facts as well as the basic rationale of risk analysis. Such an approach would have to make heavy use of statistical information, but unfortunately – if the above statement can be generalised – this would be exactly the wrong strategy.

Credibility of the information source

The credibility of the respective actor is crucial to a successful communication program. However, the public does not distribute their credits in a uniform way. Especially the British experts perceived wide variations in trust, depending on the respective actor. A representative of the British regulating authorities gave the following ranking:

> *We know that because that has been the subject of work done here in this institute, so we know who the consumer trusts. Consumer pressure groups, all the goodies. Their general practitioner, strangely enough. University professors. Less so than general practitioners. Scientists in universities are trusted far more than scientists in industry. So the baddies are ministers. Government ministers* (AUT-UK-1).

Apparently, the political institutions in the United Kingdom are not considered trustworthy by the public (AUT-UK-1, GEN-UK-2, IND-UK-1, SCI-UK-1, SCI-UK-2), and neither is the industry (AUT-UK-1, CON-UK-1, ENV-UK-1, SCI-UK-2). The apparent lack of trustworthiness was attributed to a spill-over of the BSE crisis to other fields of food production. Retail chains, on the other hand, were assigned a position of high credibility and considered to be in charge of distributing the relevant information (AUT-UK-1, AGR-UK-1, ENV-UK-1, SCI-UK-1).

However, this ranking does not necessarily hold for other countries. The Danish authorities, for example, were seen as particularly trusted by the public (IND-DK-1), while messages from the Danish industry were perceived as inconsistent (CON-DK-1, RET-DK-1). Consequently, it was proposed that the Danish authorities should supply general information about genetic engineering in agriculture and food processing, whereas the industry itself was in charge of the more product-specific information (IND-DK-1). Messages from the industry were also perceived as inconsistent in Germany (ENV-D-1) and Italy (COM-I-1, CON-I-1, ENV-I-1, MED-I-1). However, the trustworthiness of the given information may also depend on the respective domain of the application: trust is strong in medical domains, but generally weak in other domains (SCI-D-3).

Risk communication: Process aspects

According to our risk communication model, the effective implementation of a risk communication program depends on a set of process aspects: constructive interaction between the involved parties, reaching relevant target groups, feedback possibilities, and dialogue with the consumer.

Constructive interaction between the involved parties

The years with risk discussion were characterised by stable frontiers, separating the actors into two large alliances: the proponents of genetically engineered food products on the one side, and the critics on the other side (AUT-D-1, ENV-D-1, GEN-D-2, MED-D-1, RET-D-1, SCI-D-3, SCI-UK-2). A shared view was that anyone who made concessions had immediately lost (SCI-D-3). At least in the northern countries of the European Union, the risk discussion seems now to have come to an end (see above). However, the growing consensus in the expert community is not yet followed by official policy changes:

> *The public part of the debate is nowadays largely spurious: political positions require a fixation on arguments that are neither true nor even personally believed in* (ENV-D-1).

Most of the participating experts announced that their organisations would change their strategies towards more co-operation and consensus (AGR-DK-1, GEN-DK-1, CON-D-1, GEN-D-1, GEN-D-2, IND-D-1, IND-D-2, MED-D-1, RET-D-1, SCI-D-2), mainly by forming strategic alliances in information campaigns. Others thought that the public debate should be based on the 'division of labour' (CON-DK-1, CON-D-1, ENV-D-1, GEN-D-1, RET-D-1), where, for example, the role of the environmental and consumer organisations would be to point at potential risks and to ask if facts are really facts or not (ENV-D-1).

However, the process of overcoming the old discrepancies may bring its own problems. First of all, co-operation requires a definition of common goals (ENV-D-1). The difficulty of this task should not be underestimated. Even within the food processing industry, for example, attitudes towards informing the public are far from homogenous (FOO-D-1). Several parties proposed that the respective national authorities should take a moderating role in the dialogue (AUT-D-1, CON-D-1, IND-D-2, GEN-I-3). Moreover, if the different parties have finally bargained a consensus proposal, it does not immediately succeed just by convincing the particular representative (ENV-D-1). The representative, in turn, must also convince his or her organisation:

> *Even within our company there are strong barriers of misunderstanding that have to be overcome. Separate departments are separate communities, a company is a mirror of society as a whole* (GEN-D-1).

Obviously, constructive interaction within organisations must precede constructive interaction between organisations. Interactive structures were also proposed on the international level (AUT-DK-1, AUT-UK-1), for instance in developing an internationally standardised label for genetically engineered organisms (SCI-D-2). In any case, formation and maintenance of co-operative structures require a large expenditure of personal and organisational resources. The problem appears to be especially critical for the notoriously short budget of non-governmental organisations (CON-D-1, ENV-D-1).

Two social actors received special attention: the retailers and the environmental organisations. The retailers were seen as a kind of communication interface, receiving input information from the food processing industry, weighing risks against benefits, transmitting the information to the consumers, doing the 'field work' of product consulting, and functioning as a feedback channel back to the information suppliers (AUT-D-1, IND-D-2, RET-D-1). The environmental groups, on the other hand, seem to dissociate themselves gradually from the rest of the discussion. Two quotes from the German focus group discussion may illustrate the point:

> *The environmental organisations are currently not prepared to participate in any compromise... Actually, they cannot really compromise anyway because this would tear the whole organisation apart. It would be illusionary to expect sudden changes. A co-operation goal may be defined, but implementing co-operation will take much more time* (MED-D-1).

> *It must be admitted that the NGOs are not really willing to compromise. When the promotion of biotechnology is successful, we will lose contact with current developments because we have excessively maintained our positions... Our inability to co-operate is largely a matter of interest. Everyone knows that firms have interests and try to promote them. But you shouldn't forget that NGOs do also have interests that they are also going to promote, even if you cannot publicly admit this* (ENV-D-1).

Again, our data provide no basis for judging the extent to which these appraisals can be generalised. At least one point seems to be clear: the widely discussed gap between 'the public' and 'the experts' extends to the internal structure of non-governmental organisations. Maintaining certain positions is delibe-

rate policy, aiming primarily at reassuring the members, not at keeping up with the course of the discussion. In such a situation, a consensus strategy would seriously threaten the internal cohesion of the organisation, and even minor co-operation must be carefully handled so that the organisation does not counteract the interests of its members.

Reaching relevant target groups

Any given information campaign would be a waste of time if it did not reach its target audience. Indeed, there are two general approaches: (a) the respective communication agency makes the information available, but leaves it up to the interested consumer to access it, or (b) direct targeting, that is, the information is especially tailored to certain consumer segments, and it is actively transmitted using the most appropriate channel.

In the case of approach (a), there is no point in targeting, since it is defined by the *absence* of persuasive or educational purposes. It corresponds very much to the 'full information approach' to completeness of information described above. However, such a strategy requires a considerable amount of resources, but cannot make sure that the information is received and processed. A major problem here is that already a lot of information sources exist which are not as widely known as would be desirable. Establishing a knowledge base does not only mean to develop good material, but also to make it reach the target audience (GEN-D-2). The 'leave-it-up-to-the-consumer' approach may become especially questionable when the communication program is mainly concerned with the technology as such and not with specific applications:

> *Well, target it in the same way you target specific groups like pregnant women with folic acid. I think that is much more, I think just general blanket information would be a complete waste of time. With that you can spend so much money to swamp television with adverts and in newspapers* (AGR-UK-1).

In the case of the targeting approach, several strategies are possible. In a first step, the information task could be subdivided with regard to the level of generality. As one of the participating experts remarked, general information on biotechnology is so basic and, at the same time, such a lot that it would better be part of the curricula in the educational system, whereas informing about specific applications should be in the responsibility of those who are more directly involved in the respective markets (ENV-DK-1).

Most propositions concerned the targeting of important decision-makers (AGR-UK-1) and multipliers, that is, the media (IND-DK-1), the educational and the medical system (IND-D-1), and the supermarkets (GEN-D-2, ENV-UK-1), acknowledging that it is most important to make the information available at the point of sale. Others thought that the number of important target groups was so large that one might soon lose track of things (AGR-UK-1). Consequently, it would be better if each actor started with his own traditional clientele, where the respective needs are known and tailoring of information is possible without extensive market research (GEN-D-1, GEN-UK-2).

Feedback possibilities and dialogue with the consumer

The most effective utilisation of an agency's communication capacities requires a feedback loop from the recipients back to the communication agency. A communication program can profit from a channel that enables dialogue, offering immediate opportunity to adjust and re-align the content as well as the information flow. As we all remember, a leading supplier was taught quite a lesson on the consequences of direct market penetration without taking possible consumer feedback into account (RET-D-1, CON-UK-1):

> *I think the whole point is [company name]'s arrogance and they didn't realise, did no research or anything about how we would react to that. And then it all started back firing on them, no one would take responsibility for anything, no one would kind of admit publicly 'yes its our fault that we did not segregate and we have done that we would be better in the future'. No one has done anything.... you go from pillar to post* (CON-UK-1).

The most obvious dialogue-oriented strategy is to make the information available at the point of sale (COM-D-1, GEN-D-2, RET-D-1, IND-UK-1, GEN-UK-2). To a certain extent, this is already implemented in the United Kingdom, mainly in the form of leaflets. Some actors are also planning to supply the retail chains and the press with detailed brochures, informing about genetic engineering and its main applications in agriculture and food processing (GEN-D-1). However, brochures and leaflets are – like labelling – not actually dialogue-oriented channels (IND-DK-1, CON-D-1), but this could be accomplished by face-to-face product consulting:

> *Product information may be given via product testing in retail shops, where in-house personnel is available for further product consulting. This is partly important to ensure that the customer has a real person to direct his or her requests at... Such in-house product information campaigns in retail shops will expand communication into the customers' families* (COM-D-1).

However, the burden would be put mainly on the retail chains, who might face enormous difficulties in recruiting the required personnel for product consulting. At least, extensive personnel development programs would have to be implemented (RET-D-1). As an alternative, telephone hotlines were proposed (IND-DK-1, AUT-D-1, CON-D-1), reflecting a growing scepticism about the average customer's willingness to accept lots of printed information, read long brochures, take a pile of leaflets home, and evaluate detailed lists of ingredients:

> *Information about genetic engineering has to be 'served' to the consumers. They are not going to call some public authority to order some information leaflet and then read it. Consumers do not read declarations of contents either. I do not think that more brochures will do any good, instead we need telephone hotlines allowing people to call with questions, or some TV spots* (IND-DK-1).

If we put detailed scientific brochures on one end of a continuum measuring the degree of knowledge orientation of a communication program, classic advertising would certainly be located at the far end. Only two of the experts in our study (IND-DK-1, GEN-D-2) indicated that they would prefer such an approach, drawing more on persuasion than what we would usually call real information.

Risk communication: Outcome aspects

The next four sections will look at the consumer variables the different communication programs aim at: increased knowledge, problem awareness and involvement, positive evaluation, attitude change, and reduction in perceived risk, and increased trust in the information source.

Increased knowledge

Product-related knowledge is the basis for informed consumer choice. In the case of genetically engineered food products, however, an ideal knowledge base would also include more fundamental issues, particularly some highly sophisticated material from the life sciences, comparisons with other methods in breeding and food processing, and the rationale of risk assessment. Furthermore, it would include the necessary mental tools for interpreting statistical uncertainty.

As could be expected, there was a general consensus among our experts that knowledge about biotechnology was practically absent in the general public (RET-DK-1, CON-D-1, IND-D-2, RET-D-1, COM-I-1, CON-I-1, CON-UK-1, IND-UK-1, MED-UK-1, SCI-UK-2). Yet different qualifications were added to this statement: first, folk psychology was called upon in blaming the absence of knowledge to induce consumer uncertainty and, subsequently, fear (IND-D-2, RET-D-1, CON-UK-1, IND-UK-1, SCI-UK-2). An example may illustrate the point:

> *The public debate on the risks associated with genetic engineering has suffered from a lack of knowledge about scientific facts and evidence. Science should have taken a moderating role in the debate in order to make it more rational and less emotional: ignorance has induced emotion* (RET-D-1).

The underlying theory assumes that the consumer simply rejects the unknown. Logically, increased knowledge would reduce this type of uncertainty and be sufficient to cancel out the negative attitudes:

> *The consumer has no appropriate knowledge and is confused. Consumer choice should be more rational and supported by a communication program that gives information and technical aspects in a clear and scientific way, without stressing visibility and the appeal of certain risks and/or benefits* (CON-I-1).

Secondly, there would be no point in informed consumer choice when the necessary information was not represented in the consumer anyway (CON-D-1, COM-I-1, CON-I-1, GEN-DK-1). Be it the consumer organisations (CON-D-1), the industry (RET-DK-1, MED-UK-1), or its umbrella organisations (IND-D-1, IND-D-2), the relevant actors were advised not to complain but to feel in charge to change this state and make an improvement. Specifically, the proponent side proposed a general strategy change concerning the type of knowledge transmitted, replacing the public discussion of risks by a public discussion of benefits (IND-DK-1, IND-D-2, RET-D-1):

A second stage of communication has to be developed: whereas the first stage discussed mainly the risks of g.m. methods, product-development starting from enzymes and additives, and the notorious soybean issue, the second stage should turn to discussing benefits (IND-D-2).

However, it is questionable if the industry would be the best choice of a communicator. Especially in the United Kingdom, any kind of communication activity from the industry is automatically perceived as being biased (IND-UK-1, MED-UK-1), even when the subject is basically harmless:

That is the problem of lack of education in the first place, because if you try and have a discussion with somebody like that because they don't have that background knowledge, well you are biased anyway so anything you tell them is going to be wrong. Even though you are telling them the basic truth, that life is chemical, they cannot understand that because it is not part of them... The number of times you get letters saying you have got these ghastly chemicals in our food. Well the food is a chemical in the first place, you're chemical so what are you moaning about. They do not understand, they use terms so loosely because that is the word but they can't actually express what they want to say (IND-UK-1).

Problem awareness and involvement

Aiming at problem awareness as the main target variable is usually connected with an inclination to consumer rights. Moral values, but also freedom of choice, and the right to be informed are issues to which several actors wish to draw the consumers' attention. The environmentalists, for example, seem to utilise the debate to point at some deeper, underlying concerns:

The ultimate goal of our information policy is to communicate the reasons why we reject genetic engineering, which may of course imply that we can't recommend the purchase of genetically modified products, even if we don't recommend actually boycotting the stuff (ENV-D-1).

The proponents had different motives. Again (see above), someone made the point that the current bashing of genetic engineering was unreasonable and competitively unfair. Other methods in breeding and food processing would upset the consumers as well if they only looked at them a little more:

Consumers have traditionally not been very interested in how food products are produced. If they had known about the spraying of potatoes applied in chips production or about the application of radioactive irradiation in breeding to provoke mutations, they would not oppose genetic engineering. Genetic engineering simply replaces inferior techniques (IND-DK-1).

Difficulties in making this superiority popular could be overcome by focusing on the few very catchy features, for example the substantial reductions in herbicide expenditure (GEN-D-2), offering less remaining herbicides in the final products, and thus meeting the public disapproval of what is generally perceived as 'chemistry in foodstuffs'. Similarly, the notion of animal welfare could be utilised to associate genetic engineering with a moral benefit (COM-D-1).

Anyway, people would gradually become familiar with genetically engineered food products when only a reasonable form of labelling was introduced (RET-D-1). The technique as such would lose its instigating appeal (IND-D-1, SCI-UK-1), and since every news has its life cycles in the media, genetic engineering would finally follow on the path of topics like food irradiation, fading gradually out of media attention (CON-D-1, COM-D-1). Others agreed to the general point but maintained that the future would add entirely new aspects to the controversy, for example when the first transgenic animals would enter the market (COM-D-1). However, the introduction of labelling would be a decisive point (AGR-UK-1, AUT-UK-1):

> *What is going to cause the fuss is coming in when putting labels on. If there is not public reaction next year there never is going to be a public reaction, that is the acid test* (AGR-UK-1).

Yet it was doubted if minor changes in the ingredients listed on the product labels would call for enough attention to affect purchase behaviour and sales (ENV-D-1, GEN-D-2). Price would be the more important product attribute anyway, so only few consumers would bother (RET-D-1).

Positive evaluation, attitude change, and reduction in perceived risk

The former outcome dimensions, increased knowledge as well as problem awareness, are cognitive ones. Those actors who are preoccupied with consumer rights wish to enable an ideal of informed choice, and those more occupied with product sales assume that increased knowledge will finally reduce the well-known uncertainty biases in perceived risk. There are, however, other consumer variables affecting product choice, possibly more directly tangible without taking the roundabout cognitive way. An example may illustrate how persuasion works:

> *The proponents of genetic engineering have chosen an unfortunate strategy in conceding that scientific evidence is always subject to uncertainty. The opponents, on the other hand, were in fact more lucky, providing a home of elementary certainty, saying that genetic engineering will always be possibly dangerous* (COM-D-1).

Many actors have recognised that the stable negative attitudes towards genetically engineered food products are not based on knowledge but on the more evaluative dimensions, probably for the most part on negative emotional response (CON-DK-1, IND-DK-1, COM-D-1, CON-D-1, GEN-D-2, AGR-UK-1, AUT-UK-1, IND-UK-1) and a not so widely known effect of uncertainty, namely its tendency to enter consumer utility as inherent risk, thus adding another strongly negative attribute to the ones perceived anyway (COM-D-1, GEN-I-1, AUT-UK-1, CON-UK-1, ENV-UK-1, GEN-UK-1, IND-UK-1, MED-UK-1, SCI-UK-2):

> *I think the main fear is those things they don't know about. I think that is the biggest fear, bigger than any potential health risk. I think it is just, I think the main one is that they feel that science is going faster than they are and that things are happening that they don't know about. I think they are aware of their own ignorance of the issue and I think that makes them afraid. Obviously they might be concerned about complementary health problems, or, you know, control by multinationals* (CON-UK-1).

Two different debiasing strategies were sketched. According to the first one, negative emotional response can only be outweighed by objective cost and quality advantages (CON-D-1, RET-D-1). This is the perspective of informed consumer choice, maintaining the ideals of fair competition between products, unbiased perception of product characteristics, and rational decision-making on the basis of an explicit trade-off. Biased judgements are interpreted as the consequences of insufficient information. From such a viewpoint, the appropriate debiasing strategy amounts to supplying the consumer with even more information.

According to the second debiasing strategy, negative emotional response can only be outweighed by positive emotional response (CON-DK-1, COM-D-1, GEN-D-2). The representative of a leading supplier of genetically modified organisms hazarded the following statement:

> *Resistance to genetic engineering is mainly driven by emotional factors. Consequently, emotional factors have to be taken into account to establish more positive evaluations of genetically engineered food products... We propose to make use of affect-laden information in consumer markets... Information campaigns have to "emotionally unlock" the consumers* (GEN-D-2).

The underlying psychological model is that negative and positive evaluations are additive, that is, that the simultaneous presence of both evaluations does not end up with ambivalence but with the success of the predominant emotion. This is the perspective of persuasion, put into action through classic advertising in the media.

Increased credibility and trust in the information source

A message is much more likely to induce positive effects on recipient attitudes when the recipient judges the information source as credible and trustworthy. Therefore, establishing a certain level of credibility of a risk communication agency can be viewed as a necessary precondition for further information activities. Or, as the representative of a German supplier of genetically modified organisms put it:

> *The decisive importance does not lie in the information itself but in consumers' trust in the source of the information* (GEN-D-1).

Four routes to more credibility were sketched: indicating approval by the authorities, achieving more transparency, balancing the pros and cons, and public self-criticism. The official approval would be indicated on the product label, making clear that the necessary assessments have been carried out, and that the product has passed them (CON-I-1). Indeed, this would not go very far beyond what is legally prescribed.

The proponents of more transparency (ENV-DK-1, IND-D-2, GEN-UK2) predicted a positive effect on trust when the consumers were supplied with more information than the prescribed minimum, particularly concerning the regulative procedures:

I think our viewpoint is that the first level of decision making or trust is at the level of the regulators, because in advance of any crops being introduced into the food chain there was regulation in place, and anything that came into the food chain in Europe had to go through that regulatory process....There are regulatory bodies in place to look at its safety but even if that is not here is all the information about it. So if you want to find out more about it, ask us, we are here. We will be pro-active as well in trying to speak to as many people as possible. And really tackle it that way (GEN-UK-2).

The balanced information approach would give both sides of the story, risks as well as benefits. This approach avoids that the consumer can identify the attempt to persuade him. Consequently, reactance should be much less likely or at least partially cancelled out by the positive effects on consumer attitudes (IND-UK-1). The final route to trustworthiness was seen in public self-criticism, assuming that the consumers would honour a company's ability to learn from past mistakes (ENV-UK-1, IND-UK-1, MED-UK-1, SCI-UK-2):

I think we are perhaps going at it from a wrong angle because I heard an interesting suggestion recently which was that this demand for information from the consumer is rubbish. When people demand information what they may actually be saying is 'I don't trust the source of the information'. They are actually saying I don't trust the authorities, and this comes out as tell me more, tell me more. They don't actually want information they really need to trust...Well not reassurance they need to, they need just to trust the source of the information. And so they need to see sometimes the source of the information saying we have made a mistake here, honestly, exactly. And not being afraid to, I don't know, I don't really know the risks, I have made a mistake, we are taking this thing off the shelf because we realise now so and so. They need that sort of demonstration on the part of the people who are giving us this stuff and then I think they would be far more willing to accept the information (MED-UK-1).

DISCUSSION

Theoretically based on established risk communication models, and integrating previous research on the consumer-relevant risks and benefits of genetically engineered food products, this study served two objectives: first, the risks-and-benefits database provided by Smink and Hamstra (1994) should be updated. Going beyond a mere listing of risks and benefits, our second objective was to incorporate them into a communication model and investigate possible risk communication strategies as perceived by the European expert community in late 1997.

Leading representatives of the following parties were invited to participate in focus group discussions: scientific research, authorities responsible for the approval of genetically modified organisms, suppliers of genetically modified organisms, food processing industry, associations of the food industry, agricultural organisations, retail, media, professional communication agencies, consumer organisations, and environmental organisations. Four discussions were conducted in November 1997, one in Denmark, one in Germany, one in Italy, and one in the United Kingdom.

We developed a set of evaluation criteria and subjected our focus group data to qualitative content analyses. The previous section has presented the in-depth analysis category by category, looking closely at the details, but also neglecting the overall picture. Recompiling the disentangled data, we shall look now at four major issues: (a) the key risks and benefits of genetically modified food products, (b) cross-national differences between the four involved countries, (c) the central structure of the social arena in which the debate takes place, and (d) six prototypical risk communication strategies that can be derived from the data.

Key risks and benefits

The development of genetically modified food products seems to follow a generation pattern. Most products that have already entered the European market are perceived as a first generation whose quality attributes pertain to improved cultivation, processing, and distribution characteristics. Many producers hope that the second generation will take over the market for functional foods, improving the nutritional value of products and thus providing healthiness as a quality attribute.

However, this remains a pie in the sky as long as the 'second generation' is missing. Consequently, the substantial assets of genetically engineered food products reduce to price advantages. It is assumed that decreases in the price of raw materials will carry over to subsequent stages of the production chain and finally enhance the price-performance ratio of consumer goods.

A third key benefit was seen in the potential for a more sustainable production. Reduced herbicide expenditure in agriculture, for example, should meet the increased ecological awareness of European consumers. However, it is questionable if such a remote benefit can outcancel certain moral reservations that seem to be associated with sustainability as well.

Many experts perceived a biased perspective on ecological matters in the public, only weakly associated with the restoring or maintenance of ecosystem functions, but strongly associated with the very absence of cultivation. In such a belief system, genetic engineering would be evaluated as a severe threat to the fabric of nature. Yet this is a summative evaluation, related to genetic engineering as a general process. Summative evaluations, in turn, can rarely predict product purchase, so that actual consumer behaviour remains an open question.

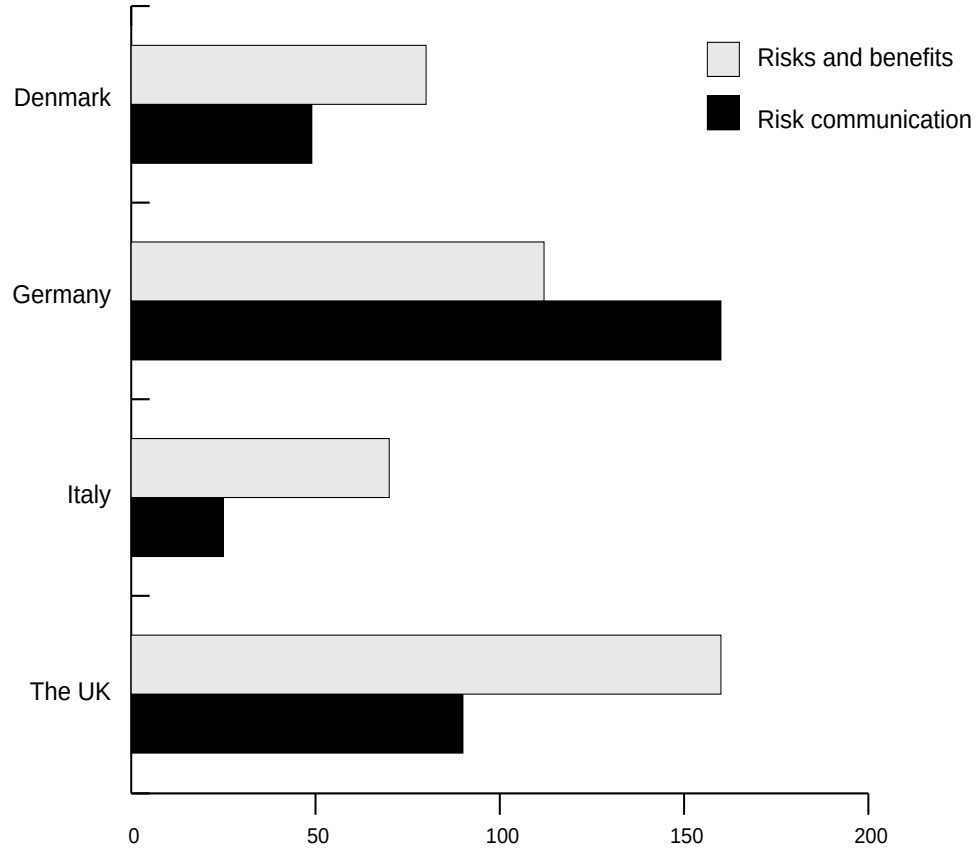
Cross-national differences

Without too much inspiration, it could be expected that the cultural differences between the four countries involved in our study would extend to the content and style of the respective national debates about genetically modified food products. By means of an expert survey, Smink and Hamstra (1994) compared the Netherlands, Italy, and Spain with respect to communication activities between the different actors. While the network was tight in the Netherlands (the graph is already given in Figure 1), they found only three established communication links in Italy (government and consumer organisations, government and social research, social research and biotechnology research), and none at all in Spain.

Strictly speaking, our data are not sufficient for a valid test of such country effects. However, they allow for a tentative analysis of differences with respect to the dominant content domains of the discussion. Going quantitative, we may compare the extent to which the focus group discussions were either dominated by risk-and-benefit issues, or by risk communication issues.

Figure 5 shows a comparison of the pooled frequencies of the risk-and-benefit benefit categories with the pooled frequencies of the risk communication categories across the four involved countries. Computing and ranking the relative proportions within the countries, the German discussion had the highest proportion of risk communication issues (54.9 per cent), followed by the Danish (34.8 per cent), the English (34.4 per cent), and the Italian discussion (24.2 per cent).

Figure 5. Pooled frequency of risk/benefit categories versus pooled frequency of risk communication categories, compared across the four countries



These results coincide with our qualitative analyses: the German experts had collectively agreed that the risk debate was over and should be replaced by the discussion and communication of benefits. In its explicit form, this statement turned also up in the Danish focus group discussion, but neither in the English nor in the Italian. Another detail from the *Health* subsection is worth considering: Whereas some British participants claimed that public health issues were generally overdone, consumer health maintenance in Italy seemed not even to work properly with conventionally produced foodstuffs.

Taken together, the apparent differences may be interpreted as the consequence of a temporally delayed onset of the risk debate, at least in Italy. However, legislation as well as the marketing of products become an increasingly European affair, forcing the respective national suppliers to become internationally competitive. If this is correct, the following years should gradually level the differences between EU countries out.

We must concede that we had actually expected more pronounced effects. Rabino (1994), for example, surveyed recombinant DNA researchers in the US and in Europe. Comparing the two scientific communities, he found that the majority of the US scientists perceived public attention as having predominantly positive effects on their work, whereas the majority of the European scientists perceived just the opposite. We had hoped to find comparable differences also within the European Union.

Our expectations were especially due to the Eurobarometer surveys, which have continuously found Danish, German, and Dutch consumers to be the ones least supportive of genetic engineering in Europe (INRA, 1993; Marlier, 1992). However, cross-national differences in consumer attitudes are apparently not mirrored by cross-national differences in expert attitudes. This is perhaps due to the fact that the arena of science is entirely international, always reinforcing immediate dissemination of research results. Moreover, trade barriers within the European Union have gradually been eliminated in the past decades, forcing the commercial arena to become European, too. All this has been going on for years now, so that pronounced cross-national differences in the expert community could actually not have been expected.

The central structure of the arena

There is often as much information in what has not been said as in what *has* been said. Recall the structure of the social arena model we introduced in the section on *Individual and social perspectives on risk* (see Figure 1). The central part of the arena is occupied by the struggling actors, controlled by a so-called rule enforcer. In theory, the rule enforcer is a government agency, which should in our case be the European Commission, partially substituted by the respective national authorities who are in charge of the approval of genetically modified organisms. However, the role of the European Commission was mentioned exactly once (!):

> *Well there are some rules in the UK. For example, we have already said as a committee that a live bacterial food supplement could not have any antibiotic resistance in it at all. And that we would look at each case on its merit but of course the European Commission overrule us then* (AUT-UK-1).

Mentioned once in four focus group discussions, involving forty-eight leading experts from four European countries. This is not too often, especially because our focus group discussions were conducted in November 1997 – which was also the date the Supplementary Regulation to the Novel Food Directive came into force, regulating the labelling of novel foods and novel food ingredients.

Additional hints can be found in the results pertaining to *Decision power over foodstuffs* (see above). Concerning the question of who actually controls the

diffusion of genetically modified food products into the European markets, the different actors showed a marked consensus: control was systematically attributed to abstract market forces, especially to the demand structure in those markets that precede the ones the respective actors are involved in. Most interesting, no-one mentioned the authorities at all, not even the officials themselves.

On the other hand, the results pertaining to *Constructive interaction between the involved parties* (see above) indicate that several actors actually regretted the restraint that was exercised by the national authorities during the years of the risk discussion. Although the European Union is now in charge of the relevant legislation, the general orientation towards more public dialogue still offers the role of a moderator to the national authorities.

Taken together, this would imply that the diffusion of genetically modified food products is in fact principally dependent on market forces. Therefore, the most important resource flows would simply be supply shocks (eg, when a new crop variety has passed the administrative procedures and enters the market, offering substantially reduced production costs) and demand shifts in the subsequent markets of the food chain (eg, when farmers expect cost advantages from growing the new crop variety). However, even a purely economic model would also include the consumer market as the final link of the chain. And consumer demand is, of course, elastic with respect to marketing and communication.

Prototypical risk communication strategies

Recompiling the in-depth analysis of the twelve risk communication categories included in our system, six prototypical strategies can be identified: (a) the scientific information approach, (b) the balanced information approach, (c) the product information approach, (d) classic advertising, (e) restoring credibility, and (f) reassuring the target audience. The strategies differ mainly by the target variables they intend to affect. The former three aim at the cognitive dimensions, the latter three are persuasion approaches and aim directly at the evaluative dimensions. Figures 6 and 7 give a graphic representation of the six strategies.

Figure 6. Graphic representation of the three cognition-oriented strategies. Highlighted boxes indicate that the strategy incorporates the respective variables, shaded boxes indicate that the strategy neglects the respective variables

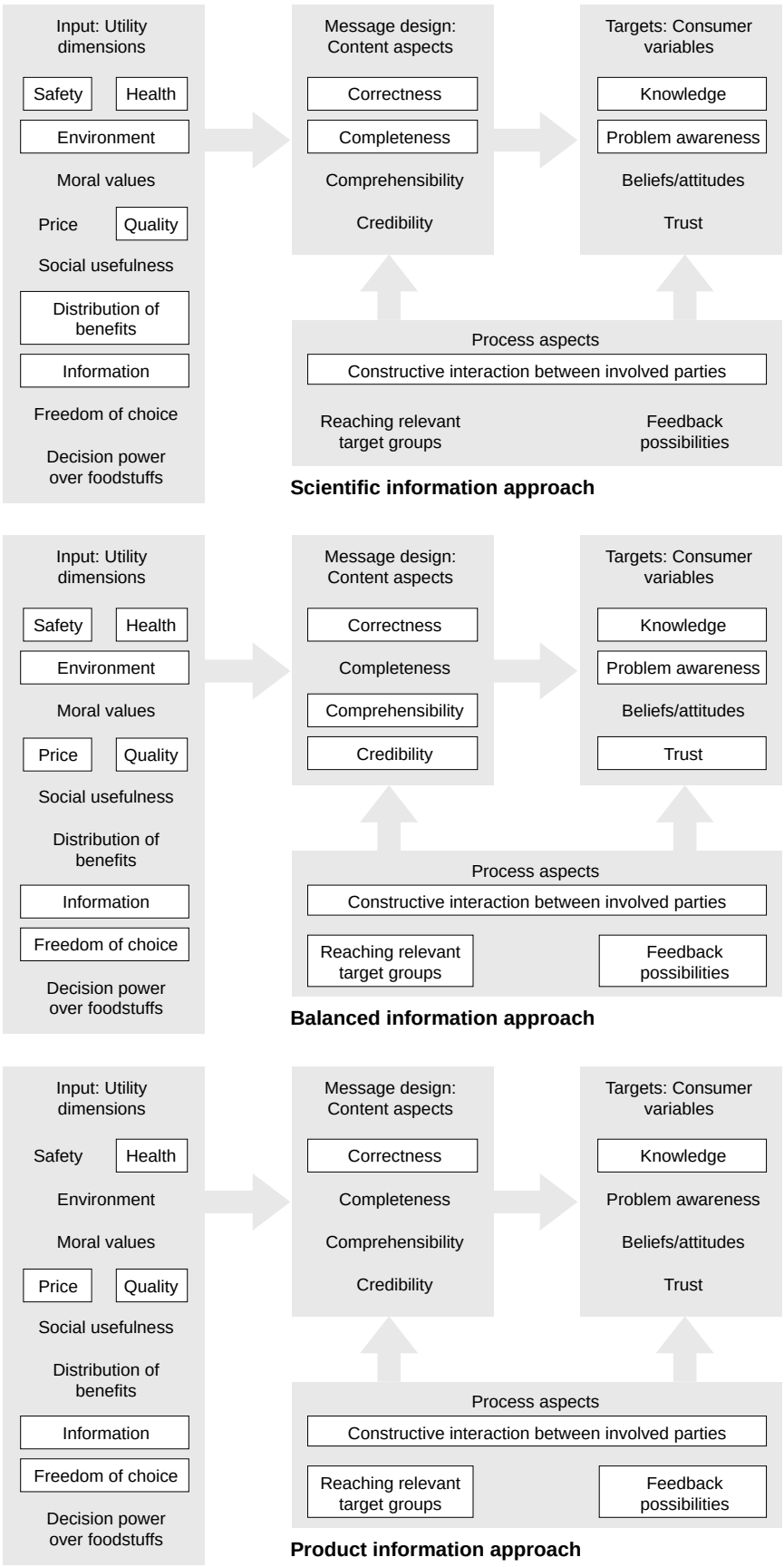
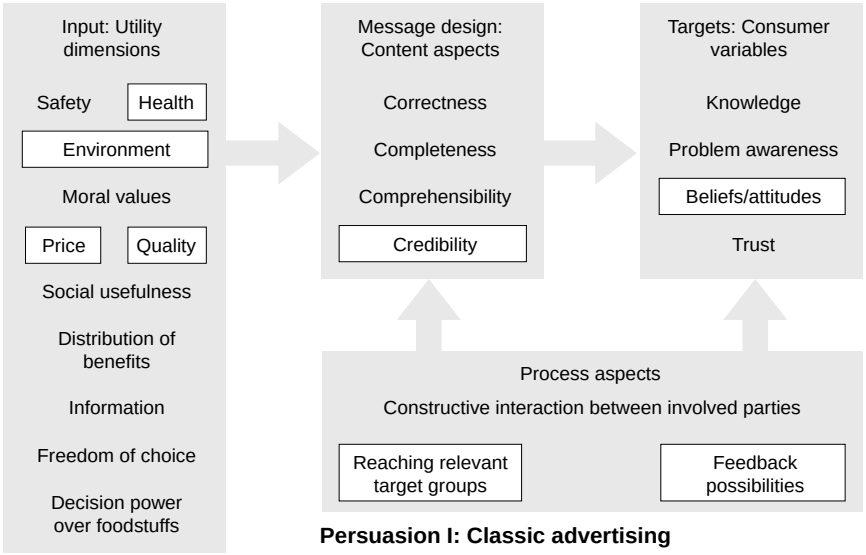
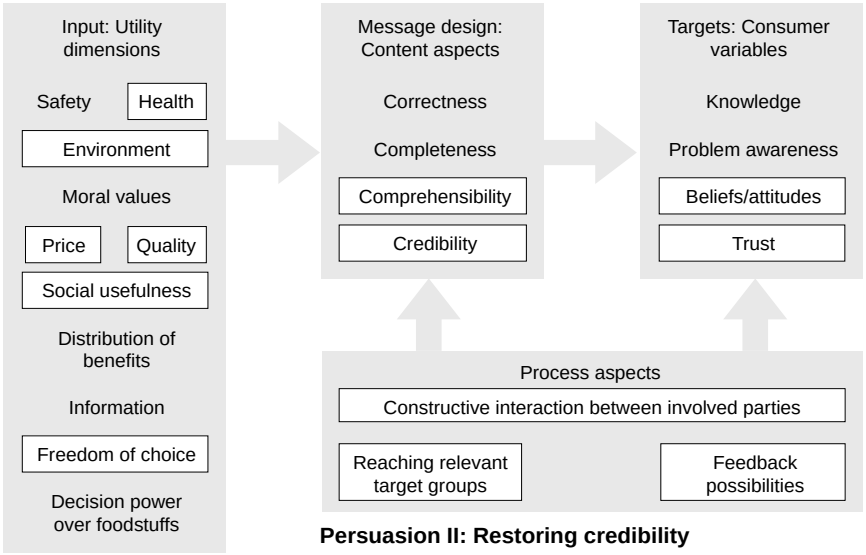


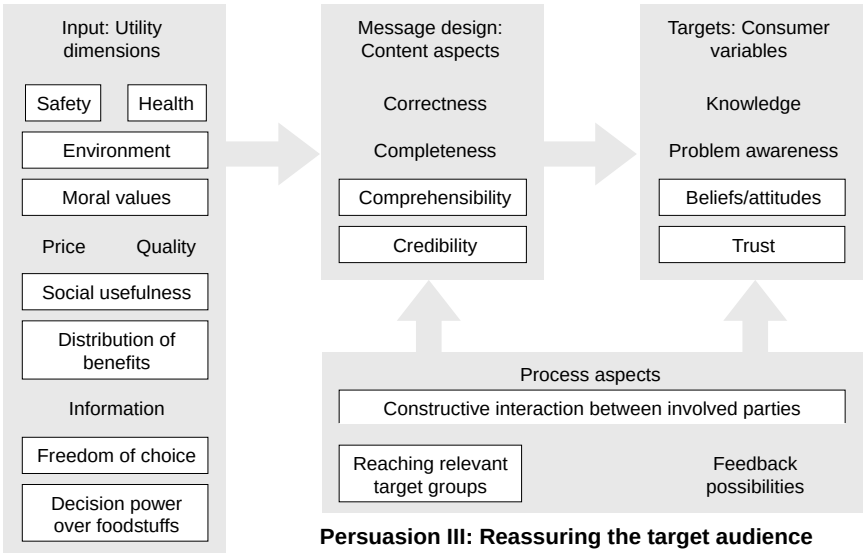
Figure 7. Graphic representation of the three persuasion strategies. Highlighted boxes indicate that the strategy incorporates the respective variables, shaded boxes indicate that the strategy neglects the respective variables



Persuasion I: Classic advertising



Persuasion II: Restoring credibility



Persuasion III: Reassuring the target audience

Deriving strategies is an idle task when valuations are omitted. Valuations must be based on evidence, and the risk communication literature indeed provides a reasonable database concerning the effects of several message characteristics (see Renn, 1992a, for an overview). However, this paper is concerned with communication about genetically modified food products. It is not known to which extent results from different risk communication tasks, from US samples, or from laboratory experiments can be generalised to our domain. Yet this is currently the only possible way. After introducing the respective strategy, we will review some selected evidence that may at least give a hint of how promising the approach is.

Scientific information approach

Type one may be called the "full scientific information approach". The input draws heavily on scientific evidence, all risks and benefits included in the message can be subjected to empirical tests. The most relevant utility dimensions are safety, health, environment, and product qualities. The evaluative dimensions are of minor importance.

The proponents of this approach feel obliged to provide the consumer with the same amount of information that is available to the experts, including not only basic knowledge on genetic engineering, but also the necessary skills for interpreting scientific data: the rationale of risk assessment, comparisons with other methods in food production, and the administrative procedures preceding the actual marketing of genetically modified organisms.

The messages are designed to be scientifically correct and complete, and aim exclusively at the cognitive outcome dimensions knowledge and problem awareness. Conclusions and recommendations are avoided, that is, the actual trade-off between risks and benefits is left to the consumer. As a side effect, the transparency and the objectivity of the approach may have positive effects on credibility. The typical communication channels are detailed brochures and large internet databases, suitable even for scientific purposes.

As indicated in the section *Completeness of information* (see above), however, it is questionable if this approach really matches the information needs in the target audience. The crucial point is that it tries to turn the interested consumer into a little scientist, supplying him with all the technical stuff that is necessary to understand scientific information. Will people make proper use of it? Some results from the existing literature may be helpful.

Johnson and Slovic (1995) investigate how lay people respond to the presentation of uncertainty in risk information. Four studies tested the effects of different uncertainty conditions (only point estimate versus interval estimate), different risk magnitudes, and the use of graphics in US samples. Their results indicate that a group of up to 20% of the respondents had no grasp of even the idea of uncertainty in risk estimates, already at loss when asked to indicate if the reported risk figure was a point estimate or an interval estimate.

Among those respondents who understood the idea, reporting of uncertainty had mixed effects. On the one hand, discussion of uncertainty appeared to signal

more honesty. At the same time, however, subjects rated the risk communication agency as less competent when uncertainty was discussed. Responses to the different risk magnitudes were rather oddly biased: low estimates were deemed more "preliminary", whether uncertainty was mentioned or not. The results pertaining to the use of graphics were inconclusive, too. In Study 2, people reading a story with graphics rated its trustworthiness lower than did people who read the same story without graphics. In Study 3, subjects indicated that they found the graphics useful.

Taken together, these results indicate that the proponents of a scientific information approach should handle their task very carefully. The idea behind the whole approach is the following: negative attitudes towards genetic engineering result simply from rejection of the unknown. Enhanced knowledge should thus automatically lead to more positive attitudes.

However, scientific knowledge is by definition subject to uncertainty – as we all know, the daily hassles of science reduce largely to picking the right covariations from a never-ending stream of white noise. Unfortunately, this is not what the general public associate with proper science. An unqualified attempt to communicate raw probabilistic information might end up with the same conclusions that can be drawn from the famous *heuristics and biases* research program (Kahneman, Slovic, & Tversky, 1982): people do not think probabilistically.

Balanced information approach

The second prototypical strategy may be called the "balanced information approach". This is a typical retailer strategy. Similar to the scientific approach, the focus is on hard facts that aim at enhanced knowledge and problem awareness. However, it does not present full-scale evidence but selects the important items and balances risks with benefits, trying not to expect too much of the consumer.

Moreover, it assures that the messages are comprehensible and do not suffer from dispute in the expert community. Clearly, the success of this strategy depends on a certain amount of credibility, but at the same time also tries to improve on it. The typical channel is a short, clear-cut brochure on genetically engineered food products in general, distributed in supermarkets and supplemented by feedback possibilities in the form of telephone hotlines, internet pages, and face-to-face consulting at the point of sale.

This approach avoids the obvious drawbacks of the full scientific information approach. Moreover, a number of experiments have shown that being explicit in the conclusions and presenting counter-arguments is more effective than operating with implicit conclusions or presenting only one side of the story (for reviews see Lee, 1986; McGuire, 1985). Therefore, a balanced information approach is probably more suitable for communicating the necessary background information about genetic engineering.

Product information approach

The third strategy may be called “product information approach“, especially favoured by consumer organisations and also some retailers. It is pretty similar to the balanced information approach, only that it focuses entirely on the single product, and not on the production technology in general. Consequently, it is not interested in trust or consumer awareness that might go beyond the actual product. The typical channels are a label on the package or a leaflet distributed in the supermarket, supplemented by telephone hotlines and face-to-face consulting at the point of sale.

The information itself is focused on food ingredients and their effects on the nutritional value of the product. To judge the effectiveness of such information, we may ask how consumers *generally* interpret nutrient content claims in food labelling and advertising. Andrews, Netemeyer and Burton (1996) conducted interviews with $N = 731$ food shoppers at malls in Boston, Chicago, and Los Angeles, asking consumers to view and respond to various types of print advertisements for soup and margarine.

The ads made either general claims of healthiness or specific nutrient content claims. Furthermore, they varied with respect to three footnoted nutrition disclosures: (a) information on the absolute quantitative level of a nutrient, (b) relative disclosure, giving absolute level, information on the recommended daily value, and percentage of daily value of the nutrient contained in one serving of the product, and (c) an evaluative disclosure type, specifying that the per-serving level of the disclosed nutrient was high according to the Food and Drug Administration criteria.

Their results indicate that consumers discount general claims of healthiness. Specific and substantiated nutrient claims lead to far more positive perceptions. Furthermore, consumers tend to generalise specific nutrient content claims to other related, but nondisclosed nutrients, as well as to the overall healthiness of the product. The most positive and specific effects were found for advertisements that included disclosure information about a negative nutrient's per-serving level, a Food and Drug Administration rating of that level, and a specification of the disease-reducing effects of a diet low in the respective nutrient.

Persuasion I: Classic advertising

The three strategies presented so far had in common that they aimed primarily at the cognitive dimensions knowledge and problem awareness. However, there are other ways to market a product. The fourth prototypical strategy was sketched by the representative of a major supplier of genetically modified organisms, and it can best be described as persuasion in the form of classic advertising.

This approach does not bother with substantial correctness or completeness. It communicates the few catchy benefits of genetically engineered food products, but discounts or even ignores the possible risks. Target groups are explicitly identified, and the information is carefully tailored to their respective needs, assuring maximum comprehensibility. The strategy aims directly at attitude

change, realising that it is not compulsory to take the long way over knowledge or trust. Typical channels are tv spots and ads in the print media.

Numerous studies on persuasion and attitude change have been carried out in other contexts. We cannot give a proper account of all the factors that influence the persuasiveness of a message; the interested reader may refer to Eagly, Wood and Chaiken (1981), McGuire (1985), or Petty and Cacioppo (1986). Yet one study deserves more attention.

Frewer, Howard, Hedderley and Shepherd (1997) adapted the elaboration likelihood model (cf. Petty & Cacioppo, 1986) to investigate persuasion in an experimental risk communication task. Using a sample of *N = 160* British consumers, they tested the impact of different levels of persuasiveness of messages about food risks on individual engagement in elaborate cognitions.

Highly persuasive information was rated as being more accurate and factual, and respondents indicated that they were more in favour of using it. The information was perceived to have greater personal relevance, both to the respondents themselves as to others. The information source was seen as being more independent and more knowledgeable about the risks, less likely to have proven wrong in the past, more concerned with public welfare, more responsible in the transmission of risk information, having a better track record, and being more trustworthy and less likely to withhold information.

Persuasion II: Restoring credibility

A second persuasion strategy industriously attempts to make the supplier more credible. In a nutshell, this strategy communicates a big “we have understood”. Since British consumers British consumers distrust industry, science, and government, the strategy is highly valued in the UK.

Concerning the input information, the trust strategy focuses on topics like decision power over foodstuffs and the right to be informed. Product-related information is neglected. Self-criticism, for example admission of past failures in approaching the public, and a new inclination to public dialogue are the dominant process characteristics, frankly displayed to the public. Again, the typical channels are tv spots and ads in the print media.

How promising is such an attempt to restore credibility? Frewer, Howard, Hedderley and Shepherd (1996) present three studies investigating which characteristics of a communication agency lead to trust in information about food-related risks. Based on two qualitative studies that provided the constructs to be tested, the final survey asked *N = 888* British consumers to evaluate 15 information sources with respect to 19 dimensions.

Trust was linked with perceptions of accuracy, knowledge and concern with public welfare. Expertise and independence did not lead to trust unless accompanied by other characteristics. Distrust was associated with perceptions of deliberate distortion of information by the source, and a history of providing erroneous information. Altogether, the results suggest that the public remember very well indeed who has tried to fool them in the past. Cautious about attri-

buting honesty to an actor, they are bound to demand a reasonable record of positive performance.

Persuasion III: Reassuring the target audience

Finally, a negative persuasion strategy can be identified, portraying the approach some environmentalists have taken (or at least was attributed to them by other actors). The input information is selected to communicate only the risks, possible benefits are discounted or even ignored. The information itself is not intended to be weighed by the recipient. Instead, the strategy communicates ready-to-use evaluations. A notorious habit is the persuasive use of statistical uncertainty to construct the so-called residual risks, that is, events of extremely low probability, but high dread potential.

Especially striking is how the credibility problem is approached here. Credibility is achieved and maintained by sticking to the same policy, continuously reiterating the same arguments, regardless of new evidence. As one of the environmentalists from our expert panel confessed, the strategy is explicitly tailored to match a need for assurance in the target audience. The typical channel is the internal newsletter, supplemented by well-directed happenings for the media, and widely distributed stickers containing persuasive slogans.

How can such a simple strategy be so successful? Brown, Homer and Inman (1998) conducted a meta-analysis of the experimental literature on the relationship between ad-evoked feelings and advertising responses. One of their most interesting results was that the effects of negative feelings on advertising responses were generally greater under conditions that did not encourage cognitive elaboration of advertisement information. This would explain why environmentalists so strongly prefer evaluative information.

Further evidence can be found in the experimental literature on risk perception. Johnson and Tversky (1983) report four experiments on the effects of negative affect on perceived risk. Negative affect (induced by a brief newspaper report of a tragic event) had a large and pervasive impact on the subjective frequency estimates of risks and other undesirable events. Contrary to the authors' expectation, the effect was independent of the similarity between the story and the risks to be judged. Any reported risk event produced a global increase in the estimated frequency of all risk events, resulting in a generalised upwards-bias in subjective risk estimates.

Taken together, the existing evidence suggests that this strategy profits from negative synergy effects. Created and amplified by the overlay of several "risk halos", they finally result in globally inflated subjective risk. Continuous reiteration of the same arguments does not lead to a growing scepticism in the target audience. On the contrary, it seems to be the key factor in the maintenance of negative attitudes.

Conclusion and future research

Six prototypical strategies have been identified, sketching six ways to communicate the risks and benefits of genetically modified food products to the public. However, the mere identification of strategies does not provide answers to all of our questions. Future research in this area should focus on five topics:

- comparing the overall effectiveness of the different strategies,
- comparing the specific effects on the different consumer variables the strategies aim at,
- segmenting the target population to account for differential effectiveness,
- testing for product-specific and brand effects, and
- investigating response delays.

This paper is only the first sub-task of the cross-national project *Consumer Attitudes and Decision Making with Regard to Genetically Engineered Food Products*. Subsequent studies will approach the open questions from different directions (see Bredahl, Grunert & Frewer, 1998): one will investigate consumer perceptions of genetically modified food products, making use of means-ends-chain theory and laddering; one will survey consumer attitudes and purchase intentions; and one will investigate the effects of communication strategies on attitude change experimentally.

REFERENCES

Andrews, J. C., Netemeyer, R. G. & Burton, S. (1996). *Consumer generalizations of nutrient content claims in advertising* MSI Report No. 96-115. Cambridge, MA: Marketing Science Institute.

Bredahl, L., Grunert, K. G. & Frewer, L. J. (1998). *Consumer attitudes and decision-making with regard to genetically engineered food products – a review of the literature and a presentation of models for future research*, MAPP working paper no 53. Aarhus: The Aarhus School of Business.

Brown, S. P., Homer, P. M. & Inman, J. (1998). A meta-analysis of relationships between ad-evoked feelings and advertising responses. J*ournal of Marketing Research, 35,* 114-126.

Dickson, D. (1984). *The new politics of science.* New York: Pantheon.

Eagly, A. H., Wood, W. & Chaiken, S. (1981). An attribution analysis of persuasion. In J. H. Harvey, W. Ickes & R. F. Kidd (Eds.), *New directions in attribution research Vol. 3*. Hillsdale, NJ: Erlbaum.

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

Frewer, L. J., Howard, C., Hedderley, D. & Shepherd, R. (1997). The elaboration likelihood model and communication about food risks. *Risk Analysis, 17,* 759-770.

Greenbaum, T. L. (1993). *The handbook of focus group research*. New York: Lexington.

INRA (1993). *Eurobarometer 39.1. Biotechnology and genetic engineering: What the Europeans think about it in 1993*. Written for the European Commission.

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

Johnson, E. J. & Tversky, A. (1983). Affect, generalization, and the perception of risk. *Journal of Personality and Social Psychology, 45*, 20-31.

Kahneman, D., Slovic, P. & Tversky, A. (Eds.), (1982). *Judgement under uncertainty: Heuristics and biases.* Cambridge, MA: Cambridge University Press.

Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., Goble, R., Kasperson, J. X. & Ratick, S. (1988). The social amplification of risk: A conceptual framework. *Risk Analysis, 8*, 177-187.

Knodel, J. (1993). The design and analysis of focus group studies: A practical approach. In D. L. Morgan (Ed.), *Successful focus groups. Advancing the state of the art,* pp. 35-50. Newbury Park, CA: Sage.

Lee, T. R. (1986). Effective communication of information about chemical hazards. *The Science of the Total Environment, 51,* 149-183.

Marlier, E. (1992). Eurobarometer 35.1: Opinions of Europeans on biotechnology. In J. Durant (Ed.), *Biotechnology in public – a review of recent research,* pp. 52-108. Dublin: Loughlinstown House.

McGuire, W.J. (1985). Attitude and attitude change. In G. Lindzey & E. Aaronson (Eds.), *Handbook of social psychology,* 3rd ed, Vol. 2, pp. 223-346 New York: Random House.

Merton, R. K., Fiske, M. & Kendall, P. L. (1956). *The focused interview.* Glencoe, IL: Free Press.

Morgan, D. L. & Krueger, R. A. (1993). When to use focus groups and why. In D. L. Morgan (Ed.), *Successful focus groups. Advancing the state of the art,* pp. 3-19. Newbury Park, CA: Sage.

O'Riordan, T. (1983). The cognitive and political dimensions of risk analysis. *Environmental Psychology, 3,* 345-354.

Petty, R. E. & Cacioppo, J. T. (1986). *Communication and persuasion: Central and peripheral routes to attitude change.* New York: Springer.

Rabino, I. (1994). How European and U.S. genetic engineering scientists view the impact of public attention on their field: A comparison. *Science, Technology, and Human Values, 19,* 23-46.

Renn, O., Burns, W., Kasperson, J. X., Kasperson, R. E. & Slovic, P. (1992). The social amplification of risk: Theoretical foundations and empirical observations. *Journal of Social Issues, 48,* 137-147.

Renn, O. (1992a). Risk communication: Towards a rational discourse with the public. *Journal of Hazardous Materials, 29,* 465-519.

Renn, O. (1992b). The social arena concept of risk debates. In S. Krimsky & D. Golding (Eds.), *Social theories of risk,* pp. 179-196. Westport, CT: Praeger.

Rip, A. (1988). Should social amplification of risk be counteracted? *Risk Analysis, 8,* 193-197.

Rohrmann, B. (1992). The evaluation of risk communication effectiveness. *Acta Psychologica, 81,* 169-192.

Slovic, P. (1992). Perception of risk: Reflections on the psychometric paradigm. In S. Krimsky & D. Golding (Eds.), *Social theories of risk,* pp. 117-152. Westport, CT: Praeger.

Smink, G. C. J. & Hamstra, A. M. (1994). *Impacts of new biotechnology in food production on consumers* (SWOKA Research Report 170). The Hague: SWOKA Institute for Consumer Research.

Smink, G. C. J. & Hamstra, A. M. (1995). *Research into consumer needs to be informed about the use of biotechnology in foods* (SWOKA Research Report 176). The Hague: SWOKA Institute for Consumer Research.

Smink, G. C. J. & Hamstra, A. M. (1996). *Informing consumers about foodstuffs made with genetic engineering.* The Hague: SWOKA Institute for Consumer Research.

Svenson, O. (1988). Mental models of risk, communication, and action: Reflections on social amplification of risk. *Risk Analysis, 8,* 199-200.