

**EXPERT AND LAY
REPRESENTATIONS OF GM FOOD:
IMPLICATIONS FOR
RISK COMMUNICATION**

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ABSTRACT

This thesis is conducted in two parts. The first part investigates expert and lay representations of GM food risk using the Carnegie Mellon University approach (Granger Morgan et al, 2002) and social representations theory (Moscovici, 1984).

Elite interviews were followed by focus group discussions with lay people to explore how GM food risks are understood by both parties. Expert and lay perceptions differ on a wide range of issues. In contrast to experts, lay participants are particularly concerned with various non-scientific risk dimensions, such as trust and values. These moral and ethical concerns cannot be addressed through the provision of scientific information alone as the Carnegie Mellon University approach suggests. Social representations theory offers an alternative to this top-down approach by showing that, rather than erroneous knowledge, lay participants' non-scientific concerns express ways of understanding GM food.

The second part of the thesis focuses on one particular non-scientific dimension of lay GM food representations, namely the concept '*messing with nature*', and examines the social construction of nature and naturalness in relation to food. 188 respondents completed an internet-administered free associations task to establish in depth what lay people mean when they judge GM food to be '*unnatural*'.

The findings show that the concept of '*messing with nature*' can be firmly established as a major risk dimension in relation to GM food. Moreover, rather than being solely material, both food and nature have significant symbolic and affective dimensions. This indicates that GM food risks are social in part- they are representations that have socio-cultural and value dimensions and with all this they are disputed. In turn, this has a range of implications for risk communication.

Keywords: *risk perception, risk communication, mental models, social representations, nature, GM food.*

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PREFACE

This thesis investigates expert and lay representations of GM food. From the wide array of biotechnological applications the case study of GM foods was chosen because in the UK (as well as in other European countries) this technology has been controversial. For politicians and industrialists alike, the case of GM food has shown that the introduction of a new technology can be severely hindered by public resistance and that efforts to persuade the public of a technology's benefits can fail if other factors are neglected. In turn, there are various lessons to be learned for how to communicate societal risk and of how to address future technological disputes.

Today it is appreciated that risk communication is more challenging than simply communicating experts' scientific risk estimates to the public, and that lay concerns, often dealing with the moral and ethical dimensions of a risk need to be addressed to avoid further public controversies. Despite of this, differences in risk perceptions have only rarely been comparatively investigated in depth, leading to a failure to understand how exactly expert and lay people make sense of risk. Hence the present thesis aims to contribute to a better understanding of expert and lay risk perceptions of GM food, with a view of offering some implications for risk communication.

As risk communication has limited theoretical foundations, it benefits from being preceded by an examination of risk in general. Thus Chapter One provides an introduction to the theoretical debates about risk, elucidating why western societies may increasingly feel at risk despite living longer and in greater safety than before and why expert and lay assessments of a risk may differ. In many ways, the kinds of risks facing society today cannot be quantified easily via 'objective' measures of science. Consequently it is increasingly recognised that the objectivist approach to risk perception, usually based on mortality statistics and the de minimis risk principle is generally unsuccessful when evaluating and communicating about societal risk.

We conclude the first chapter by proposing that while the standard model of scientific investigation remains a necessary form of risk assessment, it is no longer sufficient by itself. Yet it is not quite clear how best to proceed in order to move beyond the scientific risk assessment. Considerable work remains to be done to understand the underlying reasons, values and cultural assumptions of lay as well as expert

evaluations of risks. Essentially, as a first step it has to be understood how risk is “constructed”, by expert and lay citizens alike in order to be able to effectively communicate.

Chapter Two examines communication about risk more specifically. It is argued that because risk communication efforts have traditionally been based on the mathematical theory of communication (Shannon and Weaver, 1949), communications previously largely consisted of a unidirectional flow of risk information from expert to lay people rather than two-way communications between both parties. Yet in relation to technological risks that affect society as a whole, one-way communications have proved insufficient to alleviate social conflicts.

As risk communication is intimately intertwined with other societal issues, such as lack of trust in social institutions, it is ever more recognised that improving risk communication is more than merely crafting better messages. Although there are no hard and fast answers on how best to communicate about technological risks, in agreement with many other scholars (e.g. Funtowicz and Ravetz, 1990; Klinke and Renn, 2002) it is concluded that there is a need for greater public participation and the democratisation of science. A move away from the prevailing positivist paradigm could ensure that alternative rationalities are incorporated and that the concerns of the lay public can be efficiently dealt with.

This indicates the need for a more social psychological approach to risk that can address the concept in its complexity. Chapter Three presents the framework for the present thesis. It is divided into two parts- the first part focusing on mental models, specifically the Carnegie Mellon University (CMU) approach to risk communication (Granger Morgan et al, 2002), and the second section focusing on why we chose to synthesise this approach with social representations theory (Moscovici, 1984) in order to study GM food representations.

The CMU approach presents part of the theoretical and methodological basis for the current thesis. Essentially, the CMU approach provides a model of the causes of public sensitivities to risk, a methodology for diagnosing the roots of public risk concerns and a procedure (i.e. communication) for alleviating these concerns. It pro-

poses to interview expert as well as lay people in order to find out what both groups think about a risk and then compare and contrast these divergent risk perceptions and utilise the findings as the basis for developing risk communication interventions.

Acknowledging that the CMU approach can offer a useful framework to characterise the understanding and relevance of particular risks to people, this approach can nevertheless be criticised because of its individualistic and top-down orientation and its neglect of the origins of risk representations. Hence although the approach is claimed to support the design of relevant communication content, it is questionable whether it is sufficient to address societal risks such as GM food.

To alleviate these shortcomings we complement the CMU approach with social representations theory (SRT) arguing that this constructivist approach can help to ‘socialise’ mental models. Highlighting that representations emerge out of society and culture, SRT appreciates the social origins of risk representations. Moreover, because SRT deals explicitly with common sense, the theory may provide risk communication research with a vital new perspective on lay knowledge, which from a positivist perspective has traditionally been considered as problematic or “deviant”.

By synthesising both of the above approaches, we essentially aim to find a “middle way” between the positivist and constructivist stances on risk. By applying this joint framework to the study of GM food risk it is hoped that this thesis can offer a contribution into how a better, in-depth and more complete, understanding of the differences in expert and lay risk perceptions might potentially be developed.

Moving into Chapter Four we introduce the research design and methodology of our study. The chapter is divided into two sections. The first section focuses on the theoretical background of the qualitative methodologies utilised. We make the case for qualitative research, arguing that our objective of exploring expert and lay representations of GM food can be achieved well through the application of individual and group interviews, and free association tasks.

We then outline the procedures for the first part of our research, i.e. the elite interviews and lay focus groups. This leads us into the first of the three chapters of em-

pirical results. Chapter Five discusses the findings of the ALCESTE analysis. This exploratory analysis shows clear expert and lay divergences in GM food risk representations. Although both groups address similar topics, they seem to bring different representations to the issue. For example, experts discuss the environmental impacts of GM food largely from a physical and agricultural perspective, yet lay participants frame the discussion in terms of a broader '*nature*' debate incorporating various affective and symbolic elements. Thus the particular concern with '*nature*' by lay participants warrants further investigation.

The Atlas/ti analysis in Chapter Six provides the detail on the particularities of expert and lay discourses of GM food risk. In accordance with the CMU approach, expert and lay mental models of GM food risk are presented in the form of influence diagrams, which show clear divergences in risk representations in relation to a range of central concepts, for example health risks, perceptions of benefits, as well as various non-scientific issues. The importance of these latter non-scientific dimensions for lay risk representations in turn shows up the limitations of the CMU approach to risk communication.

As the CMU approach exclusively focuses on the technical and scientific aspects of GM food risk it is not equipped to adequately address lay people's social and moral questions such as those about trust and values. Having a rather cognitive perspective, it is in many ways too rational to address lay participants' concerns. While the CMU approach may be a useful tool for comparing divergent risk perceptions, the results show that, in relation to GM food risk, it confronts a stumbling block of how to deal with non-scientific concerns.

A significant non-scientific dimension is lay participants' perception that GM is "*messing with nature*". Our comparison of expert and lay mental models clearly indicates that lay participants' perceptions of GM food risk are influenced by the way they view nature, and more specifically, by the way the natural and the unnatural are contrasted. These findings provide the basis for the second part of the research which aims to establish what people actually mean when they say that "*GM is unnatural*". This has previously not been well explained, as the perception that "*GM is unnatural*" usually presents the culmination of an argument against GM. As this concept

may attain a particular significance especially in relation to modern biotechnologies, some of which may indeed challenge the essence of “our nature”, we investigate this concept in more detail.

To put nature into context Chapter Seven provides a brief theoretical background to the ways in which psychology has attempted to understand the concept. In psychology, nature has generally been approached from an individualistic perspective which is only of limited relevance to the present research aims. Rather, our focus is on values related to nature as well as on the symbolisms of the concept and on the ways in which nature and naturalness may be socially and culturally constructed. Thus it is argued that a more social psychological approach to nature is needed in order to move beyond the material to the important symbolic and affective dimensions of the concept. By approaching nature from a more constructivist perspective, it is hoped that the present thesis can provide a contribution to the, to date quite limited, social psychological literature on “nature”.

Chapter Eight outlines the research procedure for the second part of our study (i.e. the free associations tasks) followed by the results. Using a larger sample than in the first part of the research, lay participants were asked via an internet survey to freely associate to the stimulus words ‘*natural things*’, ‘*natural foods*’, ‘*food in general*’ and ‘*GM food*’. The aim was to establish a comparative judgement, contrasting GM food against other familiar food and nature related ‘objects’ in order to provide a frame of reference. By viewing GM food in the context of other reference points, we aimed to see the likely anchors and frames people use when they make the judgement that “*GM is unnatural*”. Data was analysed with correspondence analysis and triangulated with cluster analysis.

The results show that respondents’ judgement that “*GM is unnatural*” is influenced by a range of socio-cultural factors, such as values, taboos, perceptions of contagion and so on, rather than the physical aspects of the food *per se*. In many ways, respondents’ representations of what constitutes the natural versus the unnatural in relation to food are moral judgements. The dominant representation of GM food as unnatural can be regarded as attempts to construct a clear distinction between the “good” and the “bad”, which helps to define the boundaries of acceptability.

Chapter Nine discusses the results of both research stages putting them into their theoretical contexts, and evaluates our synthesis of the CMU and SRT approaches to risk perception and risk communication about GM food. It is apparent that the constructivist SRT framework can offer some important insights into lay people's sense-making of GM food risk. Only through the combination of both approaches can GM food risk be shown as the complex and multi-dimensional concept it so evidently is. In turn, this has a range of conceptual implications for risk communication.

Clearly, representations of GM food risk have a societal basis, often reflecting beliefs about values, nature, social institutions and moral behaviour. In this way, GM food risk, rather than being only a scientific reality, is in part a social construction. Essentially, the risk is both objective and subjective as risk representations incorporate scientific and moral and ethical dimensions at the same time. These cannot easily be divided as both together make up the social object "GM food".

In light of this we conclude the thesis by suggesting some further practical implications for risk communication. Appreciating that risk is in part a social construct means taking lay perceptions seriously. In turn, this raises questions of how to evaluate risk and of how to include non-scientific dimensions in risk assessments. The present findings suggest that the deliberation of risks that affect society as a whole and the subsequent formulation of policy can no longer be based on purely positivist risk assessments provided by scientific experts as novel technologies such as GM food raise novel social and ethical questions for which traditional science alone does not have the answer.

1 AN INTRODUCTION TO RISK

The present thesis investigates risk perception and its implications for risk communication about technologies, using the case of GM food. At least since the nuclear power controversy of the 1980s it has become recognised that risk communication is more challenging than simply communicating experts' scientific risk estimates to the public. To build a solid foundation for risk communication, it has to be understood how risks are perceived by both groups. Thus this thesis focuses on identifying and understanding the discrepancies between expert and lay assessments of GM food risk.

The practise of risk communication has only limited theoretical foundations. Therefore to put risk communication into context, it is useful to begin with an examination of risk in general. A review of the sociological, anthropological and psychological literature on risk elucidates why western societies increasingly feel at risk, despite living longer and in greater safety than before, and why scientific risk assessment may not accord with public views of risk.

We contextualise the risk debate within the overall frameworks of the competing paradigms of positivism and constructivism. These different perspectives show that risk can be conceived as both an objective reality and as a social construct.

Today it is becoming increasingly clear that the characterisation of risk as a purely objective reality is inadequate as in many cases, different non-technical risk dimensions also constitute an important part of overall risk perceptions. Of these social dimensions we highlight the moral and ethical issues, such as concerns about "nature", which have been insufficiently researched to date.

We conclude Chapter One by arguing that the move away from a purely scientific perception of risk towards the notion of risk as at least partially a social construct poses various challenges to risk evaluation, risk management and ultimately risk communication. Hence we put forward a "third way" of risk evaluation, outlining two frameworks that embrace both objective and subjective risk dimensions. These

allow for the integration of uncertainty and values, ensuring that lay concerns comprising issues apart from the scientific risk *per se* can be incorporated when communicating about risk.

1.1 A theoretical background to risk

It is well documented that as society has become safer and healthier, the public has become more rather than less concerned about risk (e.g. Slovic, 1993; Kunreuther and Slovic, 1996). As society has become more affluent it can afford the luxury of risk aversion, thus there is less and less willingness to accept risks (El Feki, 2002). Even though the advancement of technology has supposedly provided a sense of mastery over the natural world, it coincided with an unprecedented *sense* of risk (Joffe, 1999). In order to understand how the general public perceives risk and why people are increasingly sensitive to risks, it is important to comprehend how this escalating concern with risk developed. What is it about late modern society that makes people *feel* at risk?

1.1.1 From progress to risk consciousness

The past century was characterised by monumental technological progress, such as the harnessing of the atom and the writing of the genetic code. These developments went hand in hand with the optimism that scientific and technological progress would essentially solve the world's problems (Jaeger, Renn, Rosa, and Webler, 2001). For instance, in the 1950s nuclear power promised clean and inexhaustible energy that would be "too cheap to meter".

But apart from significant benefits, progress brought with it a range of unintended consequences. Now it is recognised that these unintended consequences are often risks of our human making (Jaeger et al, 2001). Thus according to Beck (1986), the transition from modernity to late modernity has transformed the collective consciousness so that society is now preoccupied with risk. Rather than being characterised by progress, Beck suggests that from the late 20th century onwards, society,

looking at a world of technological and environmental uncertainty, has been marked by risk.

For Beck

“Risk society means an epoch in which the dark sides of progress increasingly come to dominate the social debate.”

(Beck, 1991/95; p.2)

Beck’s risk society has four core developments: (1) Scientific and technological progress is undermined by its consequences, (2) Risks become uncontrollable as they become larger and transcend national boundaries, (3) The conflict over income which characterised modernity now becomes a conflict over the distribution of risk, and (4) The politicisation of risk requires the participation of the public as new arenas for debates about risk distribution are emerging outside government.

Hence today western societies are often disenchanted with technology, or at least deeply ambivalent about it (Jaeger et al, 2001). It is recognised that at the beginning of the new millennium

“Coping with risks of our own making has become one of the major challenges faced by humankind.”

(Jaeger et al, 2001; p.10)

1.1.2 The nature of post-modern risk

In the “risk society” social, political, ecological, and individual risks created through science and technology increasingly elude the control of the traditional protective institutions of industrial society. Beck (1986) proposes that science and technology have created new risks of catastrophic potential that did not exist in past times. Today’s risks- nuclear, chemical, ecological, and those resulting from genetic engineering- are of a different order from previous industrial risks (Adams, 1995). Many are not amenable to the senses. Since people cannot be sure to detect them, risks may lurk everywhere (Mol and Spaargarten, 1993).

Additionally, Beck (1986) argues that in the past, most risks were geographically circumscribed, often confined within the political boundaries of the nation producing the risks. In contrast, in line with the general developments of productive and consumptive globalisation, today many risks are global, meaning that people worldwide share a common set of risks. With the further internationalisation of national economies, technology transfer, and production processes across national boundaries, the result is the global diffusion of risks (Mazur, 1981a).

Moreover, in the past, many risks were related to a group's unique circumstances, while today the distribution of risk is no longer a question of social class or status (Beck, 1986). The risks of nuclear power or genetic engineering know neither geographical nor social boundaries.

As post-modern risks are often displaced in time and space, they pose potential dangers to future generations (Jaeger et al, 2001). This raises questions of equity and responsibility: How can society hold individuals or groups responsible for their actions when the future consequences of these actions are not foreseeable? Because they are not limited in time and space, today's risks cannot be compensated for or insured against (Jaeger et al, 2001).

In addition, science has also developed increased sophistication and precision in detecting the unwanted risks of the technologies it helped to create. This contributed to heightened knowledge and perceptions of risk as uncertainty often multiplies in proportion to the rigour of the analysis (Luhmann, 1993). Consequently, the more important the new knowledge and the more developed the analytical approaches, the greater the degree of uncertainty created (Luhmann, 1993).

1.1.3 The role of science and expertise

But science is not only responsible for the creation and measurement of new technological risks. Equally science is also responsible for the provision of knowledge about these risks (Beck, 1994). Novel technological and environmental risks cannot be understood without relying on and trusting in scientific expertise. However, this special role of expertise is problematic.

The role of experts implies the division of (intellectual) labour. Skills and forms of knowledge are carried by experts, on behalf of the public. Because experts carry this knowledge, the public does not need to (Giddens, 1991). On the one hand, this results in a gain in efficiency. On the other hand, the price of the efficiency gain is a degree of dependence. The public has to trust the expert, both as the bearer and user of knowledge (Giddens, 1991).

Yet as the societal division of labour grows more and more complex, the expectations that someone will perform the necessary calculations in a way that others can rely on are increasingly problematic (Freudenburg, 1993). Thus while the current division of labour results in an unprecedented level of prosperity, proficiency, physical health and safety, at the same time, it increases societal vulnerability to cases where duties are not carried out properly (Freudenburg, 1993).

Moreover, expert judgement is often shrouded in doubt, and the media compel people to witness the uncertainty that characterises experts' assessments of risk (Joffe, 1999). There is increasing awareness of the ubiquity of expert controversy in modern society, and of the extent to which experts have lost their independence to patrons and employers (Barnes, 1988), giving rise to the phenomenon known as "captive consultants" (Otway and Ravetz, 1984). Also, since today's human-made risks, such as those from nuclear power, have spin-offs, which even surpass the know-how of the experts who created them, it further undermines the trust that can be placed with the experts (Joffe, 1999).

Today the fallibility of expertise¹ has been repeatedly shown (e.g. in relation to BSE) contributing to a lack of societal trust. And if trust is lacking it can result in changes to the way in which people think about potentially risky issues, often meaning that behaviour which presupposes trust will be ruled out (Luhmann, 1979).

Hence paradoxically, the division of labour that fostered many of the scientific-technological achievements also has the potential to make people more exposed to

¹ Empirical research on experts' performance repeatedly demonstrated that experts know a lot but predict poorly (e.g. Meehl, 1954; 1986; Johnson, 1988), and that experts use simplifying heuristics and have biases similar to those held by lay people (Freudenburg, 1992).

risk. Because people recognise their dependency, inter-dependency, and vulnerability they increasingly *feel* at risk.

1.1.4 Reflections on the risk consciousness

In essence, from a sociological perspective, changes in the social fabric of society, the particular nature of technological and environmental risk and the lack of trust in the experts who might be relied upon for protection have created an area of uncertainty and unease, threatening people's ontological security, i.e.

"The confidence that most human beings have in the continuity of their self-identity and in the constancy of the surrounding social and material environments of action."

(Giddens, 1991; p.92)

But Beck's risk society approach can be criticised on several grounds. First, with reference to Beck's conceptualisation of post-modern risks, Rothstein, Hubert and Gaskell (2006) draw a distinction between societal risks, as proposed by Beck, and institutional risks which refer to "*threats to regulatory organizations and/or the legitimacy of rules and methods of regulation*" (Rothstein et al, 2006; p.91). Institutional risks are created through the pressures towards greater coherence, transparency and accountability of the regulation of societal risks, inevitably exposing the limitations of regulation. Thus not only is society increasingly concerned with novel risks, but equally with the risks of risk management².

Consequently, Rothstein et al (2006) argue that the concern with risk in post-modernity is less the result of the growth of societal risks as argued by Beck, but is rather a consequence of the growth of the regulatory frameworks to control these risks, as well as of the need to manage the increasing institutional risks.

² This focus on the management of institutional risks can in turn shape the perception and management of societal risks. For example, focusing of institutional risks can highlight different societal risk dimensions for which regulators could be held responsible. On the one hand, this may lead to better management of societal risks. On the other hand, it could also lead regulators to focus on the management of institutional risks (such as meeting performance targets) at the expense of efficiently managing societal risks (Rothstein et al, 2006).

Second, Wynne (1996) criticises Beck's risk society approach for focusing almost exclusively on expert knowledge, containing a top-down dynamic. As such, the sociological work on the risk society fails to specify the dynamics of the lay dimension, neglecting the ways in which lay people make sense of a risk (Wynne, 1996). Even Giddens' work which deals with the interpersonal dimension of lay knowledge fails to elucidate its culturally rooted, collective facet (Wynne, 1996). Wynne's (1992a) case study about sheep-farmers' confrontation with Chernobyl offers a contrast to this by emphasising the agenda-setting potential of lay people. This is valuable since it shows that lay people generate issues and act on society rather than constantly responding to expert agendas.

Finally, Adams (1995) finds Beck's risk society framework extremely anxiety provoking, and suggests that Beck projects his own personal myth of nature onto the whole of modern society, thus presenting a doom-laden view by focusing on the darker dimensions of science. Yet the first German edition of the "Risikogesellschaft" was published in 1986, the year of the Chernobyl disaster, giving Beck's view a sinister relevance. In addition, Beck can be credited with initially examining the particular dimensions of post-modern risks, which is at least as relevant today as it was two decades ago (e.g. in relation to the risks posed by GM or nanotechnology).

Hence even with the above criticisms, the sociological work on risk provides a useful theoretical background into how and why the societal concern with technological risk may have developed and why today, rather than progress, risk has become the defining characteristic of our age. As societal conflicts are often about the distribution of risks of various kinds, risk has become a political issue which requires political solutions (Beck, 1986). In turn, this means that the social acceptability of those risks must be confronted (Hornig, 1993).

1.2 Defining risk

Despite the ubiquity of risk in today's society it is unclear what the concept exactly represents. But the importance of adequately defining risk is widely acknowledged: the definition of risk is no mere matter of semantics, since it determines what will be

studied, and what will not (Hohenemser and Kasperson, 1982). If risk is not properly defined, it will be difficult to evaluate.

Because risk has been approached from a wide scope of scientific disciplines, such as economics, mathematics, philosophy, and psychology, there are a broad range of conceptualisations. Risk research is a transdisciplinary field and Luhmann (1993) argues that in relation to definitions, the negative consequences of this are most apparent. This means, for example, that there is no definition of risk that could meet the requirements of science as each area of research is satisfied with the guidance provided by its own particular theoretical context (Luhmann, 1993). Definitions are almost never wholly true or false, but instead, are useful as tools for abstraction and for bringing intellectual attention to a common focal point (Rosa, 1998). As with other discussions about safety and danger, social and physical scientists have been unable to agree on the nature and meaning of risk (Adams, 1995).

From a technical perspective, the term risk is often used interchangeably with hazard, while from a lay perspective it is often replaced by danger. Definitions of risk and danger are ambiguous (e.g. Luhmann, 1993) and frequently overlapping (e.g. Lopes, 1983).

Likewise, conceptually, the distinction between risk and uncertainty is blurred, but Rosa (1998) offers a useful division between both constructs. Risk implies the possibility of some positive, neutral or negative outcome- this possibility is the first indispensable element of risk (Rosa, 1998). Because humans evaluate the uncertain outcomes of their actions, certain states of the world, which are possible but not predetermined, can be identified as risk (Rosa, 1998). This lack of predetermination implies uncertainty. But not all uncertainty is risk- a third essential feature is that risk is present only to the extent that uncertainty involves some feature of the world, stemming from natural events or human activities that impacts human reality in some way (Rosa, 1998). Thus while not all uncertainty is risk, all risk involves some uncertainty. As such it can be argued that, although not the whole picture, uncertainty clearly is a defining characteristic of risk. The significance of this notion is explored later on in this chapter in relation to various risk evaluation and risk management approaches.

In brief, these various conceptualisations highlight the inherent difficulty in adequately defining a multidimensional and abstract concept such as risk. Thus rather than focusing on individual definitions, we refrain from further semantic exercises and emphasise the broader paradigmatic debate in which the different ways of understanding risk are grounded.

1.3 The conflicting scientific paradigms

We look at risk through two different lenses, positivist and constructivist, to elucidate the origins of the potential problems facing risk assessors and risk communicators today. It is important to realise that discussions about what risk is, how it is perceived, and how it can be evaluated and communicated are part of a much wider debate involving other subject areas. The objective/subjective risk controversy (of which more later) is grounded in two opposing worldviews: the Cartesian and the Hegelian paradigms.

On the one hand, the Cartesian paradigm with the ‘cogito’ “*I think, therefore I am*” has been the basis for the natural science model and is reflected in positivism and realism. It assumes that a reality exists independent of our knowledge of it and that formal logic can produce objective knowledge. The mind is seen as passive in the acquisition of knowledge. True knowledge is believed to be independent of context, with scientific laws being universal.

As a consequence of the Cartesian paradigm, there is a dualism between mind and body (the mind is thinking and the body is unthinking), between subject and object (the ‘world-in-itself’ and the ‘world-for-consciousness’ are separated), and between self and other (the lone thinker against society) (Markova, 1982). Methodologically, the Cartesian paradigm has been the dominant scientific paradigm, favouring controlled experiments and surveys to induce general laws, from the observation of facts. Hereby, it is assumed that research can study individuals in isolation. As such, the paradigm can be criticised for being essentially reductionistic and individualistic, neglecting the wider social context.

On the other hand, the Hegelian paradigm provided the foundation for the social science model, which is holistic and anti-positivist. It presumes that reality can only be known through our consciousness of it, i.e. that it is constructed. In that way there is not only one reality but many realities. Therefore we can never produce certain knowledge as in the Hegelian paradigm knowledge is a dynamic process, being constructed in the relationship between the subject (the knower) and the object (the known) (Markova, 1982). In contrast to the Cartesian paradigm, the Hegelian paradigm assumes that all knowledge is situational, and that scientific laws are contextual. Individual components cannot be understood by themselves as the sum is bigger than its parts.

As a consequence, the mind only emerges in interaction with others. Consensual validation determines what passes for truth in a given social group at a particular point in time (Gergen, 1973). This shared view of the world is reality. In the words of Fleck (1935; p.156): “*Reality is a systematic harmony of illusion*”.

There is no objective reality, nor objective facts, as all knowledge is derived from looking at the world from a particular perspective (Gergen, 1973). Thus constructivism proposes to replace the scientific emphasis on the “single best account” with a multiplicity of constructions (Gergen and Thatchenkery, 1996). Table 1.1 provides a summary of both paradigms and their respective research traditions.

Table 1.1 *Paradigm components and the objectivist/constructivist divide* (adapted from Hellstroem and Jacob, 2001; p.5)

	Objectivism	Constructivism
<i>View of science</i>	Instrumentalist, essentially truthseeking, natural science orientated, experimental, analytical reduction in defining the research object	Critical function, socially contingent, socially responsible, anti-reductionist in its attempt to expand a research problem outwards rather than narrowing them down
<i>View of reality</i>	Realist, essentialist, focus on the explanatory properties of representations of the causal structure of the world, causalist, mechanistic	Images of reality are viewed as essentially contingent on social/cultural factors. Organic types of explanatory power are sought in human actions as derived from imageries and social perceptions
<i>Ethos</i>	Strives to emancipate humans from nature	Strives to emancipate humans from social and political control

The main problem with constructivism is that it (if taken to extremes) leads to absolute relativism, where there is no reality at all. All extra-discursive phenomena are ruled out (Latour, 1994). Abandoning realism altogether is problematic as absolute relativism may lead to solipsism, i.e. the claim that all views of the world are equally valid (Rosa, 1998). Since everything is a social construction, extreme versions of constructivism cannot offer social criticism or direction for change (Jost, 1995). Assessments of multiple constructions of reality are not possible since there are no 'true' versions of it. Yet substantiating the truth or falsity of knowledge may be an important way to undermine oppressive views (Jost, 1995). Knowledge is power and equilibrating all knowledge claims can produce disturbing consequences. For example, the claim of equality of knowledge can reinforce existing power relations (Rosa, 1998). If every knowledge claim about a risk is equally correct, then those individuals or institutions with more power need only respond to any objections that their claim is as correct as any other claim that can be made (Rosa, 1998).

Regarding both paradigms' shortcomings, a strong adherence to either is unlikely to benefit the study of risk. Instead, as advocated by Adam, Beck and Van Loom (2000), it seems most fruitful to try to deconstruct these bipolar oppositions by aligning oneself neither with the realist-absolutist stance nor with the constructionist-relativist position, transgressing instead the borders between them.

1.4 Risk in the context of the paradigmatic debate

The different paradigms are reflected in the risk debate exemplified in the customary distinction between objective and subjective risk³. This distinction has equally been described as 'quantitative' versus 'qualitative' risk (Kaplan and Garrick, 1981), and as 'real' or 'actual' versus 'perceived' risk (Freudenburg, 1988; Shrader-Frechette, 1990). Often the word 'real' is used to express norms and values. Real risks are the risks as defined by scientific experts and hence are the risks people ought to pay attention to as opposed to 'seeming' risks perceived by the lay public (Shrader-Frechette, 1990). In the traditional positivist account, real risk is a matter of how

³ Although Thompson (1990) views the dichotomy as theoretically unsound, as there is no reason to believe that a risk estimate is objective or more 'real' because it is characterised probabilistically, for the purpose of clarity, we will follow this common distinction.

things stand in the world, while perceptions are reactions to the world, affecting reality only indirectly in virtue of their influence on human action (Shrader-Frechette, 1990).

Importantly, the conflicting paradigms incorporate different assumptions about the nature of scientific opinion in relation to the determination of levels of risk (Hornig, 1993). The objectivist view assumes that it is theoretically possible, if sufficient data could be collected and technical problems of analysis solved, to arrive at an absolute measure of the riskiness associated with any given technology (Hornig, 1993). In contrast, the subjectivist perspective proposes that risk evaluation takes place in social contexts and involves value judgements, i.e. that risk assessment is a social process (Hornig, 1993). Thompson (1990) distinguishes between risk objectivism and risk subjectivism. Risk objectivism views risk as a function of relative frequency (as well as other variables); such as probability of risk per unit. Risk subjectivism views risk as a function of confidence, such as trust, faith, and safety. Consequently objective/real risk is thought to be the object of natural science enquiry, while subjective/perceived risk is regarded as the object of social science enquiry (Thompson, 1990).

Accordingly, for both positivist and constructivist perspectives, there are a range of risk frameworks. To clarify the main arguments of the paradigmatic debate in relation to risk and to illustrate why scientific risk assessments may not accord with lay perceptions of the same risk, we pick out what might be termed extreme examples of both perspectives, before concluding that the concept of risk requires approaches which can bridge this gap by incorporating both subjective and objective risk dimensions.

1.4.1 Positivist approaches to risk

Much of the empirical research on risk and uncertainty originates from the theory of decision making (e.g. Tversky and Kahnemann, 1992; Tversky and Fox, 1995; Kahnemann and Tversky, 2000). Consequently risk has an essentially objectivist research tradition assuming that risk can be measured with adequate scientific instruments.

One of the original objectivist approaches is Starr's (1969) revealed preferences approach which assumes that the existing distribution of risks from natural and human-made hazards reveals the nature of societal preferences according to the implicit calculus of risks and benefits that led to such a distribution. Essentially, by trial and error, society is said to arrive at an optimum balance between the risks and benefits associated with any activity. Under this assumption, historical or current risk and benefit data is used to reveal patterns of acceptable risk-benefit trade-offs. The level of risk that has been tolerated in the past is used as a basis for evaluating the acceptability of present risks.

However, the assumption that historically accepted risks are acceptable risks is problematic. Past risks may have been at a given level not because society judged that level acceptable but because greater safety was not obtainable, or because there was inadequate knowledge about risks (Shrader-Frechette, 1985). Often data are not available to quantify all the adverse consequences that are imaginable and not all adverse consequences can be visualised in advance. Thus Starr's (1969) approach makes strong assumptions about the rationality of people's decision making, e.g. assuming that people have full information and that they can use it optimally. But even if society had arrived at a correct decision, it does not follow that those choices ought to be taken as normative for the present or future as values and societal norms change (Shrader-Frechette, 1985). These concerns motivated the expressed preferences approach, which asks people directly about their perceptions of risks and benefits (e.g. Fischhoff, Slovic, and Lichtenstein, 1979).

Another economic perspective is cost-benefit analysis (e.g. Mishan, 1971; Pearce, 1971) whereby the expected benefits of e.g. a proposed technology are simply weighted against its costs. In many risk areas, such as transport, cost-benefit analysis has been used successfully. Yet for technological risk evaluation, cost-benefit analysis is inadequate because it relies solely on economic indicators. Because risk is a multi-dimensional concept, it cannot be validly represented by a single number. Especially, when assessing technological risks not all risks and benefits can be easily translated into monetary units (Shrader-Frechette, 1985). Using a concept developed for the optimisation of market behaviour to describe technological inventions is often

viewed with unease as what is rational in the first context might not be rational in the second (Shrader-Frechette, 1991).

Although not strictly a risk evaluation approach, we also include the classical attitude model (Fishbein and Ajzen, 1975), as in the psychology literature there is obvious similarity between attitudes towards risk and risk evaluation. It seems that the relevant issue is not risk *per se*, but attitudes towards the technology associated with the risk (Otway, 1992). Ultimately, it is the technology as a whole that is accepted, rather than its risks in isolation (Otway, 1992). Fishbein et al's attitude model (1975) measures attitudes in terms of their underlying beliefs of outcomes (probability) and values (evaluations of outcomes). Attitude measurements from the model can be correlated with an independent, global measure of the same attitude object, thereby ensuring that the set of beliefs and values that people were asked to rate were salient to the particular attitude object in question. A serious limitation of much of the scaling done in risk evaluation is that it is difficult to know if the beliefs given people to rate are indeed salient and that the beliefs are the complete set (Otway, 1992).

1.4.2 Criticisms of positivist approaches to risk

Yet although conceptually clear these positivist approaches share a number of general limitations, especially when applied to societal risks.

To begin with, by seeking to reduce risk to a pure scientific reality that can be calculated probabilistically, the positivist orientation is reductionist. Understanding risk as a neutral product of science, devoid of bias, ethics, or of social shaping implies that risk assessment is only about facts to the exclusion of values (Rosa, 1998). But this claim for value-neutrality has been challenged (Rosa, 1998). Objectivist approaches, Rosa argues follow the naturalistic fallacy, a reduction of ethics to science, by assuming that a scientific solution is at the same time an ethical solution (Rosa, 1998). Especially in relation to today's high technologies which often pose questions of a moral and ethical nature this viewpoint is problematic.

Furthermore, quantifying risk by assigning numbers to it always involves some subjective and intuitive value judgements. For example, the nuclear engineer's probabil-

istic risk estimate for a reactor accident is based on theoretical models, whose structure is subjective, and assumption-laden, and whose inputs are dependent upon judgement (Luhmann, 1993). Thus as with all other data, data for assessing risk do not exist independently of human observation but always have to be interpreted (Stalling, 1990). In that way, there is no purely 'objective' risk. Unfortunately, this subjective bias in science is not always recognised as assessors often forget their own methodological assumptions (O'Riordan, 2000). As a consequence, risk assessment results are often presented as objective. In turn, policy conclusions based on the assessment are frequently more controversial and value-laden than is thought (Shrader-Frechette, 1985).

Moreover, probabilistic calculations fail from the social point of view. They ignore distributional questions such as who defines the risks and who benefits. Much of the conflict over acceptable risk arises because risks and benefits are distributed inequitably over space, time, and social class (Luhmann, 1993). Even if one knows that a nuclear power station explodes only once every twelve million years, it can nevertheless happen tomorrow, and tomorrow it can once again happen tomorrow (Luhmann, 1993). In contrast, in social calculations the calculus leaves all eventualities open for the individual case. Clearly, the assessment of the risk will differ on whether one feels that the accident could occur very soon or only at the end of the entire stretch (Luhmann, 1993).

Clarke (2005) argues that when it comes to actual disasters, such as Chernobyl, there are no 'average events' as there simply is no normal distribution of extreme events. In such instances, thinking in terms of probabilities makes little sense as it would lead to the conclusion that most risks are acceptable. Hence in these cases it is the possibility rather than the probability of occurrence that is problematic.

Despite these limitations, at present, positivism largely remains the basis upon which risk analysis is conducted (Rosa, 1998). However, there is an alternative perspective which suggests that rather than "measuring" risks objectively, one needs to focus on how society "constructs" risks.

1.4.3 A constructivist approach to risk

As a stark contrast to the above approaches and to exemplify the constructivist perspective on risk we discuss Douglas and Wildavsky's (1982) cultural theory, whereby risk is regarded as a purely socially constructed phenomenon. In essence, cultural theory postulates that what societies choose to call risky is determined by social and cultural factors (such as beliefs about taboos) rather than the objective characteristics of risks.

Douglas et al offer a culturally determined perspective of how societies select and deal with risks. Here it is assumed that societies selectively choose a few risks for attention and ignore a vast array of others. Because people cannot attend to all potential risks, society must decide which risks to fear most, which risks are worthy of attention and concern, which risks are acceptable, and which risks can be ignored. This cultural selection of risks is not linked to the physical and/or scientific reality of the risk. Rather, according to cultural theory, the selection of risk is a social process reflecting moral, economic, political, and power positions that are all value-laden and culturally constructed. Hence it is recognised that physical risks are embedded within and shaped by social relations and the continual negotiation of people's social identities (Wynne, 1992b).

This constructivist viewpoint can highlight how and why in complex societies it is to be expected that there will be considerable disagreement between the members of various constituencies, as to what constitutes a technological risk, as well as about how such risks should be managed (Rayner, 1987).

By inquiring into the origins of risk-taking decisions, cultural patterns can be discerned which Douglas et al (1982) condense into four ideal types. This typology known as grid/group analysis has two axes. The horizontal axis moves from 'individualised' to 'collectivised' and the vertical axis from 'prescribed inequality' to 'prescribing equality'. Within this grid, four '*myths of human nature*' can be found: individualists, hierarchists, egalitarians, and fatalists. This typology is discussed in more detail in relation to nature in Chapter Seven.

However, cultural theory has yet to be framed as a statistically testable hypothesis. There are no agreed units in which individuality or adherence to a collective ethos might be measured. Thus the theory remains interesting but essentially irrefutable (Adams, 1995).

1.4.4 Criticisms of constructivist approaches to risk

Apart from specific criticisms directed at cultural theory, the constructivist perspective on risk has a range of further limitations. Adopting a strongly constructivist perspective, Shrader-Frechette (1991) argues that there is no distinction between perceived and actual risks, because there are no risks except perceived risks. Although conceptually straightforward, this perception is awkward as it is close to absolute relativism. Some risks are undeniably real, not merely our cultural judgement about them (Rosa, 1998). Rosa calls this the “argument from ignorance” fallacy- if we are ignorant of some danger there is little basis for claiming that the danger exists at all, i.e. “what you do not know cannot hurt you”, a rather perilous fallacy in light of many contemporary risks, such as environmental pollution or radiation.

As such, the social construction of risk viewpoint raises a difficult philosophical issue. It can be interpreted to imply that people are incapable of perceiving what is really dangerous since there are no actual or objective risks in the world, as risk is only what people choose to say it is (Johnson and Covello, 1987). Taken to such an extreme, this perspective calls into question the logical foundations of societal risk management (Johnson et al, 1987). Viewing scientific truth as purely relative, i.e. context-dependent, may preclude a systematic cross-cultural consensus about the natural order that is independent of culture (Agassi, 1984).

All knowledge is socially constructed, but some knowledge accords better with the world, or is at least more reliable than other knowledge (Rosa, 1998). Drawing on Funtowicz and Ravetz’s (1985) framework which is discussed below in relation to risk and uncertainty, Rayner (1987) argues that a case can be made for better and worse social constructions of risk depending on the degree of scientific uncertainty in the risk estimates and on the importance of the issues to the interested parties. The further the issue is from scientific consensus and the greater the importance of the

issue, the greater will be the significance of cultural variation and the more problematic will be standards of objective reality. Appreciating that risk can comprise both objective and subjective dimensions today various frameworks aiming to bridge the gap between the two approaches have been developed.

1.4.5 Bridging the objective-subjective divide

The psychometric paradigm (e.g. Fischhoff, Slovic, Lichtenstein, Read, and Combs, 1978; Slovic, Fischhoff, and Lichtenstein, 1986; Slovic, 1987; Slovic, 1992) was one of the first frameworks to investigate both objective and subjective risk perceptions. Slovic et al's seminal studies clearly highlight the shortcomings of purely objectivist approaches to risk assessment by firmly establishing the importance of a range of subjective elements in risk perception.

To investigate risk perceptions, Slovic et al (1986) asked respondents to evaluate activities and technologies according to a number of qualities such as newness, voluntariness, and dread. Their results show that lay people possess a rich, qualitative understanding of risk, which is reproducible over a range of selected populations. Two different comparisons of lay perceptions of risk and scientific estimates of risk are given. First, lay estimates of annual mortality are compared against scientific estimates. Although estimations are not correct in absolute terms, lay people can provide a correct ordering of riskiness. In the second comparison, risk is not defined as annual mortality, but left to each participant's interpretation. Here, perceived risk does not scale as accurately with observed frequencies.

This shows that lay people, when asked in an open-ended way, naturally view risk as a multidimensional concept that consists not only of measurable, scientific aspects such as expected mortality but several other dimensions. In turn, this implies that rather than being irrational, lay people evaluate risk in ways not reflected (and not readily measurable) by traditional quantitative risk assessments. While expert judgements are more closely related to annual fatality rates than are lay judgements, lay people are shown to incorporate other considerations besides annual fatalities into their risk assessment. For example when evaluating technological risk lay people take into account the voluntariness of the risk, its familiarity, its delayed effects, and

its catastrophic potential. Therefore, rather than a probabilistic assessment, a multi-variate description is required both for defining riskiness in a scientific sense and for understanding the structure of subjective judgements of hazards (Johnson et al, 1993).

Regrettably, the methodology of psychometric studies has some limitations. Laboratory experiments and questionnaires assume a clear relationship between non-contextualised research results and the socially situated reality of participants. But risk estimates outside of the social context are insufficient for providing contextual information to the participant in the form of “cues” on which to base judgements (Lopes, 1983).

A further approach attempting to bridge the divide between objective and subjective perspectives on risk is the social amplification of risk framework (SARF; Kasperson, Renn, Slovic, Brown, Emel, Goble, Kasperson, and Ratick, 1988; Burns, Slovic, Kasperson, Kasperson, Renn, and Emani, 1990; 1993). This framework integrates micro and macro perspectives to study how risk is mediated through society, and how it becomes amplified or attenuated depending on a range of variables. Amplification is used as a metaphor describing the ways in which “*social agents receive, interpret and pass on risk signals*” (Kasperson, Kasperson, Pidgeon and Slovic, 2003; p.15). The framework links technical risk assessment with psychological, sociological, and cultural perspectives of risk perception and risk behaviour, and acknowledges how the interaction of these factors may amplify or attenuate public responses to risks. Hereby, risk is not only the experience of physical harm but a consequence of interactive social and cultural processes by which groups and individuals interpret risk. In essence, this approach highlights the necessity of taking into account social values and practises when assessing the nature of risk.

However, so far, the authors do not offer a fully developed theory of the social amplification of risk, but rather a descriptive framework. The framework could provide a theoretical base but still requires the testing and application to actual risk problems.

Nevertheless, by recognising plural rationalities rather than characterising the public as irrational and by appreciating the importance of addressing the social context of

beliefs, both the psychometric paradigm and the SARF were instrumental in helping to redefine risk from a purely objective reality to partly a social construction. In particular Slovic et al's (1986) approach can be credited with firmly establishing the importance of various other risk dimensions apart from the scientific risk *per se*, and hence showing why a purely positivist approach, based on objective risk assessments alone may be insufficient to account for lay concerns.

1.4.6 Value dimensions in risk perceptions

In addition to the non-scientific risk dimensions established through the psychometric paradigm, it is becoming increasingly clear that a number of value dimensions play a major part in people's risk perceptions. Kortenkamp and Moore (2001) propose that differences in moral reasoning often account for divergences in risk perceptions between expert and lay people. As such, the dominant positivist risk assessment methods may fail to reflect, or even recognise, some of the most significant dimensions of public concerns, i.e. those based on particular values.

Regarding risk perceptions of modern biotechnology, values have been shown to be correlated with perceived risk and acceptance of various biotechnological applications (Siegrist, 1999). Concerning the controversy over GM food it has been suggested that value divergences were indeed a main factor underlying public resistance because *"the technology embodied too many values that were at odds with society"* (Bruce, 2005; p.21).

In particular, moral issues and value-based perceptions of what is natural versus unnatural are increasingly recognised as important aspects in shaping public attitudes to biotechnology (Wagner, Kronberger, Gaskell et al, 2001). This is unsurprising, since biotechnological developments may bring about a fundamental shift of the traditional boundaries of nature and culture due to their ability to change the DNA structure (i.e. essence) of all species (Gervais, 1997). Biotechnology puts the known cultural categories in question, giving new answers to old questions such as what is a human being, what is nature, and what is culture. By offering new ways of categorising the world, biotechnology questions society's ideas about the boundaries between what is natural and unnatural (Wagner et al, 2001).

Yet empirically, these issues have only recently begun to be studied. Sjoeberg's (2000; 2002; 2003) studies were the first to identify the importance of the dimension 'tampering with nature' for technological risk perceptions. Rather than being based on scientific risk assessments, this dimension has a clear moral component concerning humanity's relationship with nature. Consequently, Sjoeberg and Winroth (1986) propose that lay people's beliefs about nature and the perceived moral obligations of man towards nature may constitute an important facet of technological risk.

1.4.7 Concluding the risk debate

Thus particularly in relation to modern biotechnologies it seems imperative to move beyond traditional positivist risk assessments. Positivist approaches to risk likely are insufficient to adequately account for lay concerns because they neglect the moral and ethical risk dimensions. On the other hand, a strongly constructivist perspective may be problematic for risk management and risk communication as it would mean that all claims to a risk could be equally valid. Both of these extreme conditions can be criticised for being reductionistic because:

"The cultural relativists attempt to reduce risk to a sociological construct, underestimating or dismissing its scientific components. The naïve positivists attempt to reduce risk to a purely scientific reality, underestimating or dismissing its ethical components."

(Shrader-Frechette, 1991; p.58)

Neither the objective, nor the subjective view when presented in their most extreme forms describes risk research well, and there are few researchers who embrace either as such (Short, 1989). Rather, most researchers treat risk as both a physical attribute and as a social construct (Jasanoff and Wynne, 1998). Thus the objective/subjective typology is merely an ideal type constructed for the purpose of identifying risk research against a common analytical framework (Shrader-Frechette, 1991).

Today it is becoming increasingly apparent that the separation of objective and subjective risk can no longer be maintained. A 1992 report by the Royal Society recog-

nised that the view of a separation between objective and subjective risk is no longer a mainstream position. Rather, it is increasingly acknowledged that risk is, at least in part, culturally constructed and that both the adverse nature of events and their probability are subjective to an extent.

Hence in agreement with Hellstroem et al (2001), in the present research, the understanding of risk as an objective property of certain processes and situations and of risk as the socially constructed outcome of power relations and communications are both relevant.

1.5 Uncertainty, science and policy making

By grounding the debates over risk in the competing paradigms positivism and constructivism we have highlighted some of the challenges facing risk assessors and risk communicators when trying to define and evaluate risk. A particular source of difficulty in risk evaluation, management and communication resides in the inherent uncertainties of science. The evaluation of uncertainty poses a problem because it clearly goes beyond the quantifiable dimensions of a risk and consequently always requires a degree of interpretation.

The problems addressed by risk analysis often defer solution because they are outside current experience and knowledge (Otway, 1992). They have been discovered either as unexpected or unwanted side effects of an existing technology or as theoretically projected side effects of a new and untested technology (Otway, 1992). This means that in these situations the risks are both unknown and unknowable within the current scientific understanding.

Yet politics requires certainty from science for its authority, meaning that severe demands are placed on the scientific community to make aspects of economic or political actions that are uncertain less intimidating (Wynne, 1987). The paradox is that policy decisions about a risk are likely to be most urgent just where scientific knowledge is the most uncertain (NRC, 1983). In this sense, policy makers often demand more definite risk assessments than scientific experts can confidently give.

This is problematic because uncertainty in risk evaluation leads to uncertainty in policy and vice versa, meaning that value judgements need to be made at each step in the risk policy process, from assessment, over management, to communication (Lindblom, 1959). In real life, some uncertainty always remains, and it therefore requires not calculation but judgement.

1.6 The “third way” of risk evaluation

Consequently, assessors and regulators are increasingly required to move beyond the quantifiable aspects of a risk. This implies that science, in addition to the usual scientific evidence, may also need to appraise the values that lead scientists towards certain questions and answers in order to account for the interpretation of uncertainty. As uncertainty cannot be readily “measured”, several approaches have been developed aiming to *enrich* science to be able to efficiently account for this uncertainty.

1.6.1 The tripartite division of risk

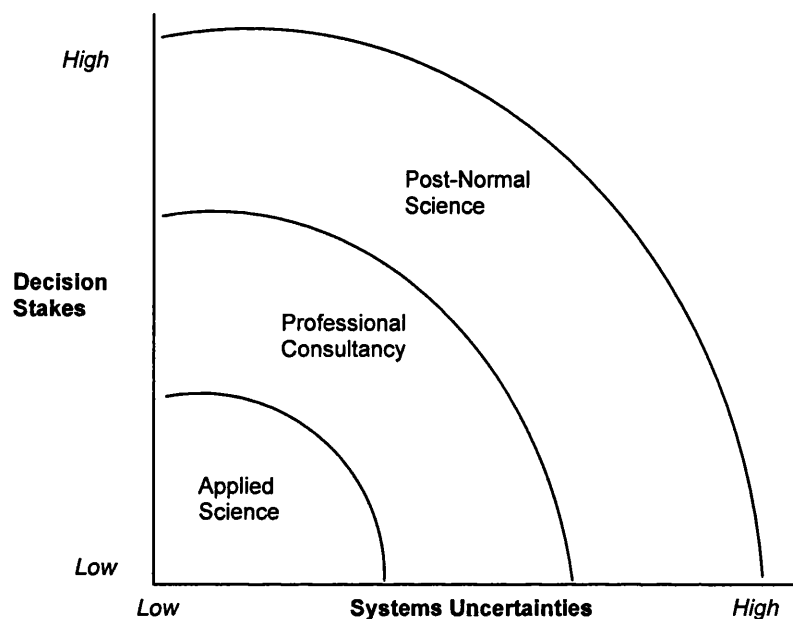
Funtowicz and Ravetz (1992) argue that traditional positivist science is unprepared for uncertainty and values and consequently is insufficient to evaluate many societal risks today. Appreciating that in some cases no amount of resources can provide scientific answers, Funtowicz et al suggest a move towards *post-normal* science.

Funtowicz et al (1990) divide scientific uncertainty into three categories: a) Inexactness, i.e. significant errors referring to the spread of data, b) Unreliability, i.e. referring to confidence levels in estimation, and c) Border with ignorance, i.e. denoting uncertainty about model completeness and covering emissions due to lack of knowledge. These categories respond to the three sources of uncertainty: a) Data uncertainty, b) Modelling uncertainty, and c) Completeness uncertainty due to lack of knowledge⁴.

⁴ For a similar, albeit four-dimensional division of uncertainty, please see Rowe (1994). Also, it can be argued that when discussing their “four problems of risk” Douglas et al (1982; p.5) already hint at a similar division.

On this basis Funtowicz et al (1990; 1992; 1993; 1996) developed the tripartite division of risk. As shown in figure 1.1 this approach offers a diagram with the axes systems uncertainty and decision stakes to use as a heuristic rather than a metric tool.

Figure 1.1 *Problem-solving strategies* (from Funtowicz and Ravetz; 1996; p.175)



Accepting qualitative distinctions, applied science deals with problems low in both dimensions, professional consultancy is involved when either is significant. But in some cases, either or both dimensions are on the extreme position, so that the traditional methods are inadequate. This “wild” area lying beyond professional practice is termed *post-normal science*. Problem situations involving post-normal science are ones where, typically, facts are uncertain, values in dispute, stakes high, and decisions urgent. Because applied science and professional consultancy are inadequate, something extra must be added onto their practice, which bridges the gap between scientific expertise and a concerned public. Thus post-normal science comprises a dialogue among all the stakeholders in a controversy. “Normal” science is still central, but there must be an extended peer community using extended facts such as anecdotal evidence and lay views. In short, it is a democratisation of science, in the sense of bringing science in the public arena.

Essentially, Funtowicz et al (1990) argue that in many contemporary risk problems, the stakes are so high and the uncertainties so great that a new kind of science is needed to provide credible and useful answers. This new science must depend on extended peer communities and extended facts to be able to efficiently address the policy decisions that lie ahead for risk management.

As a criticism, it can be questioned whether this new sort of practice is still science. However, Funtowicz et al (1992) argue that science has continually evolved and will evolve further responding to the changing needs of humanity. In their view, the traditional problem-solving strategies of science, the philosophical reflections on them, and the institutional, social, and educational contexts need to be enriched to solve the problems created by our science-based society. Although as a post-normal science, risk assessment is vulnerable to attacks of subjectivity and arbitrariness, the emphasis is on *enriching* normal science with post-normal science, thus “getting the best of both worlds”.

1.6.2 The risk management escalator

Klinke and Renn’s (2002) risk management escalator is a similar, albeit pragmatically more developed approach of a three-step risk assessment specifically addressing the challenges of complexity (i.e. the problem of identifying and quantifying causal relations), uncertainty and ambiguity in risk management. Interestingly, here there is a distinction between uncertainty and ambiguity. Uncertainty refers to a situation where factual statements are unclear, comprising different components such as statistical variations, measurement errors, ignorance and indeterminacy (WBGU, 2000). Ambiguity refers to a situation whereby views about the desirability and severity of a given risk are contested, as Klinke et al suggest that most scientific disputes in risk analysis and management are not about differences in methodologies and measurements. Rather, the issue is what all of this *means* for human health and the environment (Klinke et al, 2002).

The challenge is now how to effectively include ambiguity into the risk assessment. While uncertainty (except indeterminacy and ignorance) can be resolved through cognitive advances, ambiguity can be resolved only through discourse, such as legal

deliberations and public participations (Klinke et al, 2002). Hence risk management decisions in this realm must be based on technical assessments combined with social evaluations. Figure 1.2 provides an overview of the different resolutions for varying risk conflicts when one moves from simple, to complex, uncertain, and ultimately, ambiguous risks.

Figure 1.2 *The risk management escalator- from simple via complex and uncertain to ambiguous phenomena (from Klinke and Renn, 2002; p.1090).*

<p><i>Routine operation</i></p> <p>Actors: Agency staff</p> <p>Discourse: Internal</p>	<p><i>Scientific risk assessment necessary</i></p> <p>Type of conflict: Cognitive</p> <p>Actors: Agency staff External experts</p> <p>Discourse: Cognitive</p>	<p><i>Risk balancing necessary</i></p> <p>Risk assessment necessary</p> <p>Type of conflict: Cognitive Evaluative</p> <p>Actors: Agency staff External experts Stakeholder, e.g. industry, directly affected groups</p> <p>Discourse: Reflective</p>	<p><i>Risk tradeoff Analysis and deliberation necessary</i></p> <p>Risk balancing necessary</p> <p>Type of conflict: Cognitive Evaluative Normative</p> <p>Actors: Agency staff External experts Stakeholder, e.g. industry, directly affected groups Representatives of the public(s)</p> <p>Discourse: Participatory</p>
Simple	Complex	Uncertain	Ambiguous

Clearly, ambiguous phenomena may result in conflicts of a cognitive, evaluative as well as normative nature. The case of agricultural GM often perceived as risky by lay people because of social and moral reasons (Hampel and Renn, 2000) offers an obvious example. Hereby, people disagree for example about the social need for GM food, and the moral implications of the technology- concerns which cannot be addressed by scientific risk assessments alone. Rather, they require some form of participatory discourse for conflict resolution because:

“The risk issues in this debate focus on differences of visions about the future, basic values and convictions, and the degree of confidence in human ability to control and direct its own technological destiny. These wider concerns require the inclusion of those who express or represent them”

(Klinke et al, 2002; p.1087)

In brief, both Funtowicz et al (1992) and Klinke et al (2002) agree that there are some risks, namely those incorporating a high degree of uncertainty/ambiguity, which can only be effectively assessed and managed through increased public participation and a democratisation of science because the problem of interpreting and addressing uncertainty cannot be solved by scientific risk measurements alone.

Both approaches comprise objective as well as subjective risk dimensions, ensuring that issues apart from the scientific facts *per se* are incorporated in a risk assessment. This may help to find a balance between the necessary reliance on experts and the democratic desire to incorporate public values and preferences. Habermas (1971) argues that expertise is unduly dominant. To keep expertise in its appropriate place, strong, reflexive interactions between lay and expert cultures are required (Habermas, 1971). The above approaches recognise the need for increased public participation and point to the inevitability of a shift in risk communication. Although still in its infancy stage, this ‘third way’ of risk assessment and management looks promising as it may provide a more complete risk evaluation by allowing both expert and lay perspectives to be included. The fact that the gap between expert and lay perceptions of risk is widening (Porritt, 2000) despite risk communication efforts indicates that new approaches are urgently needed.

1.7 Conclusions Chapter One

In conclusion, despite controversies surrounding the meaning of risk and the ways in which it should be evaluated, there is a near consensus over several key issues. Post-modernity has brought society risks, which cannot be easily quantified via traditional ‘objective’ measures of science alone. While the standard model of scientific investi-

gation remains a necessary form of risk analysis, in many cases it is no longer sufficient.

Thus there is a need to devise better, more inclusive procedures for the democratic management of risk in society (Rosa, 1998), which anticipate the, sometimes conflicting, interplay of 'objective' and 'subjective' issues. As society can be expected for some time to struggle with the evaluation and management of technological risk, it is essential to find better ways of incorporating the views of lay citizens into the decision making process (Hohenemser et al, 1982).

Most scholars agree that this can only be achieved through a paradigm shift incorporating augmented public participation. Traditional positivist science, embedded as it is in its cultural context, can still pursue objectivity as an ideal (Krimsky, 1992), but needs to be enriched through a form of post-normal science, that allows for the incorporation of uncertainty and values. This need reinforces the importance of continuing to define the risk field as inherently interdisciplinary because:

“Risk is a topic involving scientific investigation where the philosophical dictum of separating the technical from the moral, and the categorical from the normative is relentlessly blurred”

(Rosa, 1998; p.16)

2 COMMUNICATING TECHNOLOGICAL RISK

Having introduced the debates over the problems of defining and evaluating societal risk, the present chapter examines risk communication more specifically. We put risk communication in the wider societal context by providing a background to its emergence in modern society, concluding that there is a need for the experts and a desire by the public for improving risk dialogues. However, it is argued that because risk communication efforts have traditionally been based on the mathematical theory of communication (Shannon and Weaver, 1949), they previously largely consisted of a unidirectional flow of risk information from expert to lay people rather than two-way communications between both groups.

A brief historical background is followed by an examination of what defines risk communication today, and what are its goals and rules. Although there has been a move towards more participative two-way dialogue, risk communication is still fraught with difficulties. On the one hand, there are technical challenges related to the content and evaluation of a communication. On the other hand, problems are connected to the wider societal context of a communication, such as trust, credibility and the role of the media. Lastly, it is argued that risk communication may be especially challenging in relation to food, as food risk may be characterised by dimensions not shared by other hazards, such as its particular social and moral significance.

2.1 Risk communication in the context of the risk debates

Risk communication has to be seen in the wider context of risk debates. In the previous chapter we established that there is a particular concern with risk in late modern society and that societal risk assessment and management are often contentious, characterized by polarised views, and pervasive controversies. Hence it is unsurprising that risk communication today is a developing industry. Reflecting the conflict between positivist and constructivist paradigms, the emergence of risk communication as a research theme is closely linked to various issues that symbolise the discord between scientific and lay risk perceptions.

Problems in communicating risks often originate in the marked differences that exist between the two languages used to describe risk: the scientific, statistical language of experts and the intuitively-grounded language of the lay public (Powell, 1998). The differences between these two languages constitute barriers to dialogue and co-operative understanding which need to be broken down to facilitate more productive exchanges between the two spheres (Powell and Leiss, 1997). While on the one hand scientists and industrialists criticise the public for behaviours they judge to be irrational, on the other hand the public feels similarly antagonistic toward industry and government (Slovic, 1993).

Consequently risk communication is often framed as an activity intended to close the gap between expert and lay perceptions (e.g. Powell et al, 1997; Sandman, 1985). To close this gap, there are two competing options. The traditional approach attempts to bring the public's perception in line with that of the experts (Wilson, 1979), while the opposing view argues for making the experts into better listeners (Hornig, 1990). One side proposes a technical, positivist, realist or modernist understanding of truth and knowledge, while the other suggests a constructivist, relativist or post-modern alternative. In this way, issues surrounding risk and its communication are symptomatic of larger culture wars (Thompson, 1999).

In many cases, this gap cannot be closed because scientific and public apprehensions of a risk are framed by fundamentally different values (Powell et al, 1997). This is problematic as in all risk situations where some public response is called for, what occurs in this gap can have significant consequences, such as the emergence of a 'risk information vacuum' (Powell et al, 1997). A risk information vacuum arises through the failure to implement good risk communication practises. Since society abhors a vacuum, it is therefore filled from other sources, such as the views of certain interest groups (Powell et al, 1997).

Clearly, the discrepancy between scientific expertise and lay perceptions and demands is challenging, leading to questions of how to incorporate both groups' needs to best communicate about risk. Although it was traditionally assumed that public perception must be brought into conformity with scientific rationality, as a result of the developments in risk perception research outlined in the previous chapter, it is

becoming recognized that deviance may not be the appropriate metaphor for understanding differences between “technosphere” and “demosphere” (Plough and Krimsky, 1987). Rather, only with a better understanding of the different rationalities of lay and expert people can risk communication be transformed to a communication built on mutual understanding and learning (Plough et al, 1987). This may lead not only to an improved public understanding of (and engagement with) science but equally to scientists better understanding public perceptions. Because of the divergences in expert and lay perceptions, and the heightened sense of risk that many people experience, it appears that the public is increasingly keen to have their voices heard on issues related to science and technology, and in a democratic society it might be argued that government ought to listen.

2.2 Democracy or why communicate about risk

“Citizens of a democracy expect to participate in debate about controversial political issues and about the institutional mechanisms to which they sometimes delegate decision-making power. A problem formulation that appears to substitute technical analysis for political debate, or to disenfranchise people who lack technical training, or to treat technical analysis as more important to decision-making than the clash of values and interests is bound to elicit resentment from a democratic citizenry. Because of such reactions to them, problem formulations that attribute technological conflict to widespread public ignorance only exacerbate the conflict”

(NRC, 1989, p.20)

A central premise of a democratic government- the existence of an informed electorate- implies a free flow of information. Suppression of relevant information is not only wrong, but also, in the longer term, usually ineffective (NRC, 1989). Hence Powell (1998) suggests that the growth of interest in risk communication is driven by four motivations. First, it is driven by a requirement for, or desire by, government to inform the public in the participatory democracies of politics, second, by desires to overcome opposition to decisions, third, by a desire to share power between government and public groups, and fourth, by a desire to develop effective alternatives to direct regulatory control (Powell, 1998). Underlying these motivations is the recogni-

tion that decision-making in democratic societies is becoming more public and inclusive and increasingly driven by non-experts.

Public concerns need to be taken seriously, because in a democratic society, at least in theory, the mandate for science to operate comes from the public, through taxpayer funded research, consumer purchases and political support (Powell, 1996). More pragmatically, the public can stop operations that are perceived to pose a threat to health and safety. In the case of GM foods, public opposition significantly slowed and in many instances hindered the market introduction of the technology. The fact that decisions formerly exercised solely by scientists and politicians are now often subject to extensive public debate, indicates that public opinion in defining policy for technological issues is taken increasingly seriously.

Because of the nature of decisions over technological risk, its discussion inevitably leads to the issue of power relations in society. Thus the issue of power, specifically, of knowledge merging with power, is central to the risk debate (Ravetz, 1990). Whoever has the power to select the technologies that will be developed and deployed is also implicitly shaping the future of society (Ravetz, 1990). Likewise, those who control the discourse on risk will most likely also control societal power distributions (Adorno and Horkheimer, 1944).

Recent catastrophic events (such as BSE) have graphically demonstrated the fallibility of experts and undermined confidence in the UK government, that uncritically used expert advice while often neglecting public concerns. Thus much of the opposition to technological developments can be interpreted as public demands for more democratic control of technology (Otway, 1992). Technical issues "*often serve as surrogates for even more contentious questions of political and social control*" (Hilgartner and Nelkin, 1987; p.45). Similarly, Wynne (1982) stresses the importance of acknowledging the social relations of technology. Thus risk communication needs to be contextualised, incorporating the broader issues of how authority is generated and maintained, and how conflicts about risks should best be interpreted.

Evidently, expert assessments of risk are essential to the making of informed choices in everyday life. To ignore the results of scientific risk assessments (ever-changing as

they are) is to merely substitute an informal deliberative process for a formal one (Granger Morgan et al, 2002). But because citizens in a democracy increasingly want to have their say in decisions about societal risk management, Powell et al (1997) suggest that the public's informed consent must form the basis for the collective allocation of resources for risk control and reduction. Unfortunately, past risk communication efforts often failed to empower the public in risk debates, neglecting their perspective, focusing instead primarily on information transmission from expert to lay people.

2.3 A background to risk communication

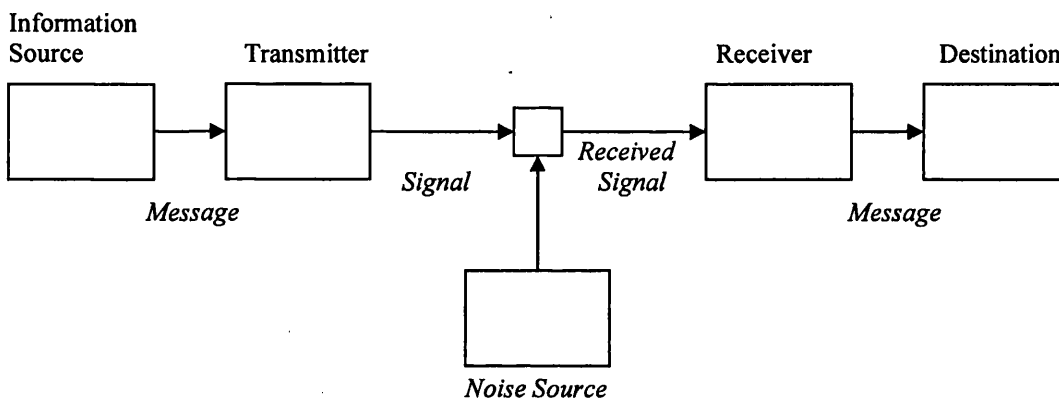
One of the reasons for the prevalent top-down approach can be found when looking at the background to communication. Research on communication gained prominence in the 1920's. Since Laswell's (1927) research on propaganda the audience has predominantly been seen as a passive target, blindly responding to stimuli. The media were thought to act like a 'hypodermic needle', showing their direct, undifferentiated impact on atomised individuals. With his formula "*Who says what in which channel to whom with what effect?*" Laswell provided a lasting conceptual framework for communications research (Mattelart et al, 1998). However, it is the mathematical theory of communication (Shannon and Weaver, 1949) which, as the original linear communication model, underlies much contemporary risk communication. With this model, the social sciences adopted the assumption of the neutrality of the transmitting and receiving instances (Mattelhart et al, 1998).

2.3.1 The mathematical theory of communication

Shannon et al (1949) symbolically represented the communication system in five parts, as reproduced in figure 2.1. An information source produces a message or sequence of messages to be communicated to the receiving terminal. The information source selects a desired message out of a set of possible messages. A transmitter operates in the message in some way to produce a signal suitable for transmission over the channel. The channel is the medium used to transmit the signal from transmitter to receiver. The transmitter changes this message into the signal, which is sent over

the communication channel from the transmitter to the receiver. The receiver is a sort of inverse transmitter, changing the transmitted signal back into a message, and handing this message on to the destination. The receiver performs the inverse operation of that done by the transmitter, reconstructing the message from the signal. The destination is the person/thing for whom the message is intended. Thus the function of the transmitter is to encode, and that of the receiver to decode, the message. In the process of being transmitted, certain unintended things are added to the signal, which are called noise.

Figure 2.1 *The communication system according to Shannon and Weaver (from Shannon and Weaver, 1949; p.6)*



The word information here must not be confused with meaning. Two messages, one which is loaded with meaning, and the other which is pure nonsense, can be exactly equivalent as regards information (Shannon et al, 1949). Perhaps the mathematical theory of communication should rather be called a ‘theory of information’. The neglect of any form of meaning is a serious limitation, since most significant messages do have meaning. Thus the theory also fails to account for how messages are understood by the receiver or the intention behind their transmission. Further, it neglects the context in which the communication occurs. Hence unsurprisingly, risk communication efforts based primary on the mathematical theory generally proved ineffective.

2.3.2 The move towards two-way communication

Today, it seems that there has been a move away from such top-down models of communication which neglect the social context and tend to rely on one-way mechanical causality. For instance, abandoning the linear model, systems theory (e.g. Laswell, 1963; Bauer, Pool and Dexter, 1964) aimed to understand the totality and interaction between elements rather than linear causal sequences, and to grasp the complexity of systems as dynamic wholes made up of many changing relationships. Similarly, Mattelhart et al (1998) argue that the notion of isolated communication as a deliberate, conscious act has been replaced by the idea of communication as an ongoing social process, whereby the role played by the receiver is just as important as that of the transmitter. This finally acknowledges the relational and interactive processes of communication.

Hence it is appreciated that entering into communication with someone creates the expectation of a social relationship, and it is this expectation that allows information to become communication (Otway and Wynne, 1989). In like manner, entering into communication with the public about the risks to which they are exposed may lead them to assume that they will play a more significant role in shaping the decisions about these risks (Otway et al, 1989). Thus it is insufficient to interpret risk communication requirements solely as a matter of providing credible information that the public will believe and passively accept. As the mathematical theory of communication shows there is a difference between providing information and communicating. Genuine communication involves sustained relationships in which mutual trust and respect are nurtured (Otway et al, 1989). In this sense, risk communication is not an end in itself- but rather only an important means to facilitate the continual development of relationships.

2.4 Communicating the risks of new technologies

To lessen societal conflicts about new technologies there is an evident need for improved risk communication efforts. As discussed in the previous chapter despite a considerable effort, many people in industrialised nations see themselves as increasingly vulnerable to technological risks and believe the worst is still to come. Gov-

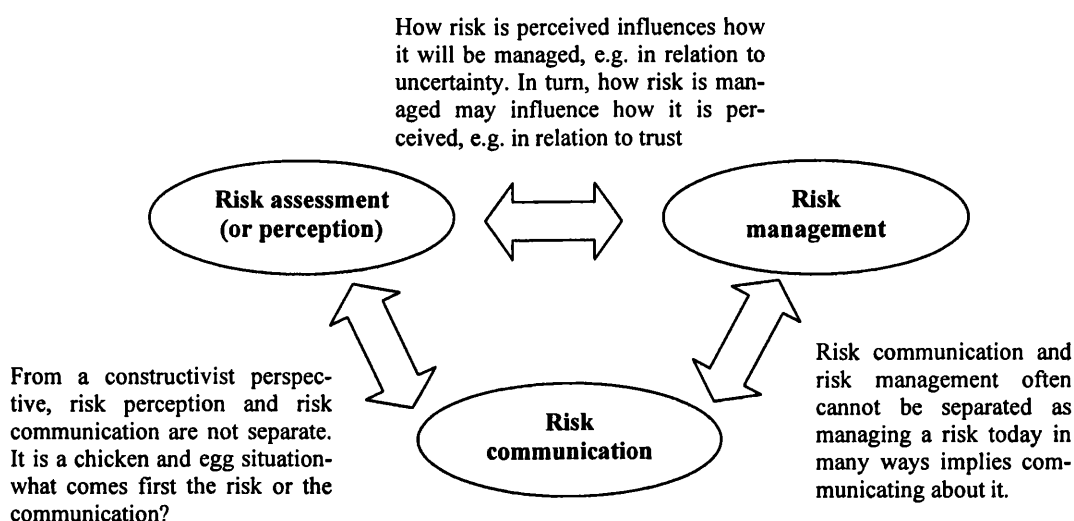
ernment regulators are caught between a fearful and dissatisfied public on the one side, and frustrated industrialists and technologists on the other (Slovic, 1992). An urgent need to communicate is generally perceived by all but it is still unclear how exactly to proceed. Hence what characterises technological risk communication, and what its goals, rules and potential problems are first needs to be clarified.

2.4.1 Definitions of risk communication

How risk communication is defined, what it should contain and how it is structured depends on what its goals are and what the audience is supposed to do with it. Overall, in accordance with the findings of the risk perception literature, definitions of risk communication have evolved from being quantitatively driven and scientifically orientated to integrating qualitative factors and lay perspectives.

Risk communication is a subset of the overall field of risk analysis. The NRC (1989) distinguishes between three stages of risk analysis: risk assessment (the scientific assessment of the risk), risk management (the incorporation of non-scientific factors to reach a policy decision) and risk communication (traditionally the communication of a policy decision and related advice to the public). Although these are often treated as distinct areas in the literature, figure 2.2 indicates that these fields are in many ways closely related.

Figure 2.2 *The interacting fields of risk analysis*



Emphasising the importance of connecting these three fields, Glickman and Gough (1990) propose that good risk communication practice is of equal importance to the other key elements in the overall risk analysis process as it has become clear that without good communication, risk assessment and risk management may be mostly in vain. Nevertheless, we focus predominately on risk perception and risk communication, as an in-depth investigation of the often technical risk management aspects is beyond the scope of the present thesis.

Risk communication has previously been narrowly characterised as an intentional information transfer designed to respond to public concerns about risk. Hereby, information is channelled from experts to the general audience. Conventional definitions of risk communication center on the intentionality of the source of information and the quality of information. For example, risk communication has been defined as

“Any purposeful exchange of scientific information between interested parties regarding health or environmental risks.”

(Covello, von Winterfeld, and Slovic, 1986; p.172)

This definition has five components: Intentionality, content, audience directed, source, and flow. But limiting risk communication to scientific information raises questions: Are claims of lay people in news reports about environmental hazards excluded? What relevance has the term interested parties? For instance, while the public may not react to government warnings about the risks of smoking, few would disqualify these messages as risk communication (Plough et al, 1987).

Today, the definition of risk communication has widened to incorporate a two-way dialogue between experts and the public (e.g. Krimsky and Plough, 1988; Kasperson and Stallen, 1991), whereby experts recognise the validity of citizens' view. Risk communication is increasingly viewed as a reciprocal process of interactive exchange of information, providing the content of risk messages as well as balance in views and accuracy of the message (Glickman et al, 1990). In essence, risk communication can refer to any public or private communication that informs individuals about the existence, nature, form, severity, or acceptability of risks. For the present thesis, we adopt the NRC's (1989) definition of risk communication as

“An interactive process of exchange of information and opinion among individuals, groups and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management.”

(NRC, 1989; p.21)

This definition emphasises reciprocal communication, and includes what Plough et al (1987) term the *symbolic* element of risk communication, i.e. the recognition that communication is not necessarily only about risk but could also be about responsibility and accountability for certain events. The following section explains in more detail the possible aims of a risk communication.

2.4.2 The goals of risk communication

At the most basic level, risk communication is hoped to balance out or at least reduce the differences between expert and lay perceptions. This overall aim can be broken down into a range of objectives concerned with the goals, and the processes by which to achieve those.

Zimmerman (1987) argues that effective risk communication is hampered by uncertainties with regard to both goals and processes. A goal-oriented framework focuses on end-results, i.e. what should the communication achieve. In contrast, a process framework focuses on how to structure the risk message and communicate the risk. Renn et al's (1991) approach outlined in table 2.1 addresses both perspectives.

Table 2.1 Objectives for a risk communication (adapted from Renn and Levine, 1991; p.178).

-
1. *Enlightenment* function (to improve risk understanding among target groups)
 2. *Right-to-know* function (to disclose information about hazards to potential victims)
 3. *Attitude change* function (to legitimate risk-related decisions, to improve the acceptance of a specific risk source, or to challenge such decisions and reject specific risk sources)
 4. *Legitimation* function (to explain and justify risk management routines and to enhance the trust in the competence and fairness of the management process)
 5. *Risk reduction* function (to enhance public protection through information)
 6. *Behavioural change* function (to encourage protective behaviour or supportive actions toward the communicating agency)
 7. *Emergency preparedness* function (to provide guidelines for emergencies)
 8. *Public involvement* function (to educate decision-makers about public concerns and perceptions)
 9. *Participation* function (to assist in reconciling conflicts about risk-related controversies)
-

This extensive list demonstrates the variety of goals that can be associated with risk communication programs. Overall, avoiding all conflict is not a realistic goal for risk communication- rather the more moderate goal should be to have fewer and better conflicts (Fischhoff, 1995). Also, although increasing trust and credibility certainly is not the sole objective of risk communication, many objectives, such as behavioural changes or fair participation, rely on a minimum of trust among the communicators in order to be effective (Renn et al, 1991).

There is no general agreement in society about when the objective of risk communication should be to inform so people can make their own independent decisions, and when it should be to manipulate, so as to induce behaviour desired by the communicator. There is wide, if not universal, agreement that attempts to manipulate behaviour are appropriate when people are faced by large, immediate dangers, such as a volcanic eruption (Granger Morgan and Lave, 1990). But there is much less social agreement about the legitimacy of trying to change behaviour in the face of less immediate risks (Granger Morgan et al, 1990). Evidently, risk communication has different goals in different contexts. Problems may arise because what is ethical in one context may be unethical in another.

2.4.3 Ethical issues of communicating risk

Because risk communication carries the potential for both good and harm (Kasperson and Stallen, 1991) the ethical status of risk communication is contentious. Whether risk communication is ethical depends on what it aims to achieve in a particular situation and how these aims are to be achieved. Pessimistically, Jasanoff (1987) argues that risk communication is often a code for brainwashing by experts or industry trying to persuade the public that the risk of a technology is small and should be ignored. In contrast, Sparks and Shepherd (1994) propose that rather than manipulating public opinion, the goals of risk communication are policy decisions and public discussions based on the best information available. In essence, it is a vital activity if lay people are to make informed decisions regarding risks (Granger Morgan et al, 1990).

Clearly, risk communication efforts need to be seen as committed to the public (rather than say, industry) interest in order to establish and maintain public trust.

Still, ethical problems can arise when there is a mismatch between the objectives of the communicator and recipient of a message. Also, covert motivations are more likely to present ethical problems than overt ones, because recipients may not know how to decode the message (Granger Morgan et al, 1990). Selfish motivations are problematic because recipients have to disentangle what is good for them from what is good for the communicator (Granger Morgan et al, 1990). Yet successful ethical risk communication is not just a matter of good intentions and a thoughtful analysis of motivations. Risk messages must be understood by recipients and their impacts and effectiveness must be understood by communicators.

2.4.4 Evaluating risk communications

In order to assess the impact of its efforts, any risk communication needs to be evaluated. How to evaluate the success of a risk communication depends largely on its goals. If the goal is behavioural change, the most demanding criterion of evaluation is whether the recipients do what the communication recommends, what Shannon et al (1949) termed the effectiveness problem. However, this would require recipients not only to understand the message but also to see it as relevant to their personal circumstances. Clearly, when evaluating the success of communications, it is important to be realistic about the path from understanding to action (Granger Morgan et al, 2002). This path is notoriously difficult as a change in attitude does not automatically lead to a change in behaviour but may be mediated, for instance by social normative beliefs (Ajzen and Fishbein, 1980).

In the past, the success of a communication has often been measured by the degree to which the public's attitudes reflect technical rationality, attributing a lack of convergence to a failure of risk communication (Plough et al, 1987). But this proved to be an unrealistic expectation. Risk communication cannot be expected to always reduce conflict and smooth risk management. It may not result in a consensus over controversial issues, which are often clashes of values and competing interests (NRC, 1989). Instead, communication is in the first place only an operation bringing a diffuse world into focus on a statement, which in the further course of communication can encounter a positive or negative response, i.e. acceptance or rejection (Luhmann, 1993). The more people know about a technology, the more they will like or dislike

it (Maharik and Fischhoff, 1993). Hence risk communication can be considered successful only to the extent that it, first, increases the base of accurate information that decision-makers use, and second, satisfies those involved that they are adequately informed with the limits of available knowledge (NRC, 1989). To achieve these aims, there are several established rules of risk communication.

2.4.5 The rules of risk communication

For the most part, the literature on risk communication is rather descriptive, dominated by approaches instructing “how to do risk communication” providing guidelines for communicating about risk (e.g. Covello and Allen, 1988; Covello, Fischhoff, Kasperson, and Morgan, 1993; Powell et al, 1997).

Most approaches stress the importance of honesty, public inclusion, of admitting uncertainty as well as of placing risk communication into context. Risk messages should avoid risk comparisons which trivialise the concern and ensure completeness, including the nature of the risk, the nature of the benefits that might be affected if the risk were reduced, the available alternatives, and management issues (NRC, 1989). A communication must be clear, interesting, and useful to lay readers, as well as balanced, correct, and understandable to technical experts (NRC, 1989). The key to effective message development is the recognition that individuals respond to risk messages based on their previous knowledge and experience (Needleman, 1987).

In order to make messages understandable communicators need to present information in a familiar way, as unfamiliar language such as technical terminology, can be difficult to understand. Commonly, wording problems arise with issues involving scientific controversy or uncertainty⁵. When the scientific community is divided, the different views may need to be explained (Granger Morgan et al, 2002). Furthermore, the wider societal climate (e.g. of trust) has to be understood. Also, it is important to capture and focus the public’s attention, and to stimulate interest as interested

⁵ Thompson (1999) proposes that when people believe that there is no risk associated with e.g. food consumption, they do not believe that there is zero probability of harm. What they believe is that under normal circumstances there is no reason to be particularly mindful of vague possibilities that lurk in the background. While experts talk about risk in the sense of probability as degree of harm, the public is talking about risk in the sense of problems that deserve further consideration and monitoring.

people take up information more readily (Covello et al, 1988). Since the mass media has a powerful role in constructing lay people's understandings of and attitudes about risk, media interactions are vital (Covello et al, 1988).

Thompson (1999) criticises these procedural approaches, arguing that the more these techniques are deployed as a way of limiting the distorting effects of information reliability, the more people tend to think of them as ethically questionable. Stressing the differences in expert and lay discourse Thompson recommends four rules for ethical risk communicators. First, never say 'risk' when you mean 'probability'. Second, never say 'there is no zero risk' because although there are no circumstances in which the future holds zero probability of harm it does not follow that everything involves risk. Third, empower when possible. And fourth, recognise that everyone is responsible for public trust (Thompson, 1999).

Jasanoff (1987) condemns the term 'risk communication' as dangerously misleading because it suggests that communication by experts is the key to trust. The weakness of the top-down approach is exactly its tendency to view things from the perspective of the scientific community rather than the audience, as well as its concentration on technological benefits rather than risks (Durant, 1995). Desvousges and Smith (1988; p.480) agree:

"Too often, risk communicators are more concerned with educating the public, rather than first listening to them and then developing communication policies."

2.5 From risk communication to risk democratisation

Our brief review of general communication theories shows how these have moved away from one-way to two-way communication. Evidently theories of communication have conceptually advanced during the past decades, and it can be argued that risk communication has followed this pattern. Looking at the historical developments in risk communication indicates a move towards more participative communications, and a possible democratisation of risk issues.

In the past, risk communication has commonly been thought of as consisting only of one-way messages from experts to non-experts. The assumption was in line with the information deficit model: if the public better understood the technology and the science of risk calculations, they would be more accepting of the risk/technology in question. But as societal conflicts about risk have shown, this focus on one-way messages proved too limiting. Hence today, risk communication is becoming a more interactive process of exchange of information and opinion among various stakeholders. While in the “old” risk communication experts simply tried to persuade lay people of the validity of their risk assessments, the “new” risk communication models, such as Funtowicz et al’s (1990; 1992) and Klinke et al’s (2002) approaches, emphasise active dialogue and public participation.

The developments in risk communication practise show the usefulness of grounding the discussion in the theoretical debates about risk as the appreciation of divergent risk perceptions was a necessary basis for improved risk communication efforts. Changes in the risk communication paradigm went hand in hand with the recognition that ‘subjective’ lay perceptions are not necessarily ‘irrational’ and ‘ignorant’. Looking at the “*Historical stages in risk perception*” in table 2.2 shows how the risk communication framework has advanced until the current 7th stage.

Table 2.2 *Historical stages in risk communication* (from Fischhoff, 1995; p.140)

-
1. All we have to do is get the numbers right.
 2. All we have to do is to tell them the numbers.
 3. All we have to do is explain what we mean by the numbers.
 4. All we have to do is show them that they have accepted similar risks in the past.
 5. All we have to do is show them that it is a good deal for them.
 6. All we have to do is treat them nicely. Non-verbal cues are also important when communicating.
 7. All we have to do is make them partners.
-

The last stage takes on the public as partners in risk management opening a two-way communication channel, implying a democratisation of expertise. This is in line with Funtowicz et al’s (1992) framework outlined in the previous chapter. The democratisation of political life is now commonplace and its hazards are accepted as a small price to pay (Funtowicz et al, 1992). Hence as suggested by Funtowicz et al a parallel democratisation of knowledge could be achieved through enhanced participation in decision-making. Facilitating democratic dialogue about the deployment of certain technologies calls for responsiveness to public concerns. Hereby, accurate reporting

of risk information alone may be insufficient (Hornig, 1993). Rather the social context influencing risk evaluations needs to be included, as no amount of information on probabilities of harm will serve to create a favourable climate of public opinion unless the broader issues are also addressed (Hornig, 1993). Although clearly presenting a challenge to the prevalent status quo, Funtowicz et al (1992) regard this democratisation of science as the most effective system for avoiding future public controversies.

But the acceptability of the wider public involvement is dependent upon risk assessors abandoning the notion of risk estimation as a pure science (Hurst, 1998). It appears that with the recognition of informal subjective aspects as essential dimensions as discussed in Chapter One, risk assessment is moving away from being solely a matter of science. Once it is accepted that two inconsistent decisions can be rational and consistent on their own grounds, it is possible to reach beyond the deviant model of risk communication (Funtowicz et al, 1992). It is only when risk assessment is considered as a “post normal science” that the new frameworks (e.g. Funtowicz et al, 1991; 1992; Klinke et al, 2002) make sense as an approach to risk-based decision making.

2.5.1 Current developments in risk communication

Moving away from one-way communications, recent development of risk communication strategies show that the validity of lay risk perceptions is being increasingly recognised and appreciated. The seminal House of Lord’s report on Science and Society (2000) advocates direct, open and timely public dialogue, appreciating that it is vital for lay perceptions and values to be recognised, respected and weighted along with the scientific risk dimensions in order to gain public acceptance for scientific-technological issues.

Thus it appears that risk communication is moving in an inclusive direction. For instance, recent GM debates (e.g. GM Nation?⁶) indicate attempts at widening risk communications to incorporate increased public participation. It could be argued that

⁶ It is appreciated that this event was flawed in several aspects, such as the translation of the findings into the report and the unrepresentative sample (Rowe, 2005). However, GM Nation can be credited with being the first event of its kind in the UK, with lessons to be learned for the future.

we are already seeing the occurrence of post-normal science, with the increasing number of public debates, consensus conferences and in the consultations of ethic committees. As debates on technological developments touch fundamental ethical considerations, policy makers have begun to incorporate ethics into the decision making of science and technology policy. However, so far, the form and method by which ethics are incorporated varies greatly between countries, and importantly, its actual impact on policy making is highly ambiguous. Nevertheless, there is an increasing institutionalisation of ethics committees, and it needs to be resolved whether this should be followed by the institutionalisation of other alternative stakeholders such as the lay public.

At present, there are a range of innovative and exciting ideas for the involvement of lay people to bring a broader range of views into scientific decision-making. For instance, advocating more openness and dialogue between scientists, policymakers and the public, the governmental think-tank Demos proposes “*upstream engagement*” to involve non-specialists in setting research priorities. Their “*See-through Science*” approach argues that public engagement needs to move upstream, to an earlier stage in science funding and research (Willis and Wilsdon, 2004). Yet it remains to be seen whether public engagement can take place at an early stage in R&D processes and, equally how the reflective capacities of scientists can be strengthened to address social, ethical and political questions.

With this in mind, it is also increasingly recognised that there are potential barriers that may discourage scientists from taking part in science communication activities. For instance, Baroness Greenfield (2005) argues that it is particularly difficult to get scientists to communicate because:

“They get resentful- they are defined by their corpus of knowledge, and if you suggest that they could share this out they see it as a threat to their identity.”

(Greenfield, 2005; p.604)

Thus paralleling the advocates, the advance of public participation has its critics. Luhmann (1993) argues that the semantics of ‘participation’ are largely ideological

in appeal, providing a kind of self-satisfaction in demanding participation, thus placing the opposing side in a position where it cannot reject the demand, or only with difficulty. From a political point of view it is above all a weapon, an instrument for forcing the political opponent to justify himself (Luhmann, 1993).

The wider public involvement is also controversial because it raises questions of who the new participants would be, how interactions would be managed and how conflicts would be resolved (Hood and Jones, 1996). Thus far, no exact frameworks exist for public participation and its subsequent evaluation. Public participation is further impeded by the lack of, or difficulty in, establishing participatory institutions (Kasperson, 1986). Lastly, communicating with the public about risk can increase their desire to participate in or otherwise influence decisions about the control of those risks, thereby making risk management even more cumbersome (NRC, 1989).

Therefore it remains to be seen whether and how these developments in public engagement are going to meet their demands. As such it can be questioned whether society, in response to the previous one-way risk communication strategies, may be moving too far or too fast in the participatory direction as so many problems remain unresolved.

2.6 Challenges of risk communication

Today risk communication is still fraught with dilemmas. Apart from lacking a theoretical basis, risk communication presents practical problems. On the one hand, these are related to technical issues such as the content of a risk communication. On the other hand, challenges are connected to the social context of communicating, for instance the climate of trust in society, and the role of the media.

2.6.1 Message and communication problems

The NRC (1989) distinguishes two major types of problems in risk communication: problems deriving from the institutional and political systems and problems of risk communicators and recipients. The first category includes problems of legal consid-

erations, such as statutory mandates and informed consent or the 'right-to-know' requirements, which influence the options available to risk managers and thus the content of their risk messages, and potential biases in the provision of information. Those most strongly motivated to communicate about risk are often also those with the strongest interest in the decision (NRC, 1989).

The second category describes problems encountered by the sources and recipients of risk messages. These include for example problems of capturing and focusing the public's attention. Moreover, a message may not be regarded as accurate if, for instance, the communicator is (or is perceived to be) advocating a position, or has a reputation for deceit (NRC, 1989). Even if communicators are honest, "telling it like it is" is not easy, and may not ensure a risk being understood like it "is" (Granger Morgan et al, 1990). Telling a risk in any one way may mean telling it in a biased way. Yet trying to correct this problem by presenting several stories that use different framings may lead to confusion (Granger Morgan et al, 1990).

Risk messages can be controversial for many reasons. As indicated in the previous chapter, the risks they describe are often themselves controversial, incorporating enough uncertainty in the underlying knowledge to allow different experts to draw contradictory conclusions. On the one hand, more thorough explanation of uncertainty surrounding technological risk may enhance trust and citizen decision-making (e.g. Johnson, Sandman and Miller, 1992). On the other hand, presentations of uncertainty have been found to have little effect on risk perception (e.g. Sandman, Miller, Johnson, and Weinstein, 1993; Kraus, Malmfors, and Slovic, 1990). Therefore regulators and society are in difficult positions. Communicators must balance scientific uncertainty and quantitative assessments about risk, and also appreciate the concerns and potentially different value judgements of the lay public.

While experts may be accused of hiding their subjective preferences behind technical jargon, often a message that is precise must be so complex that only an expert can understand it (NRC, 1989). Messages that non-experts can understand necessarily present selected information and are thus subject to challenge as being inaccurate and incomplete (NRC, 1989).

In sum, risk messages are difficult to formulate in ways that are accurate and clear and able to satisfy all parties. But even if the message content is technically well structured, a range of (social) problems may remain. Therefore, whereas an understanding of risk characterisation and of both expert and lay biases in judgement is important for effective risk communication, the broader social factors also need to be considered. Neglecting social and political arenas is prejudicial, as risk messages are not created and transmitted in a vacuum.

2.6.2 Trust and credibility

An important aspect of the social context of communication is concerned with the special role of trust. Trust is important for all forms of human social interaction and an essential dimension of social life and institutional viability (Garfinkel, 1963). What the public expects of experts is reliable advice, what the experts expect of the public is trust. We are required to trust experts because under the conditions of modernity none of us can ever have access to all the specialist knowledge on which expertise depends but the flip-side of the coin of trust is doubt (Giddens, 1990). However today, there is a well documented crisis of confidence in business and government institutions (e.g. Lipset and Schneider, 1987; Pharr and Putnam, 2000). Moreover, scepticism is endemic in public attitudes towards science and technology (Slovic, 1992).

This is problematic for risk communication as copious studies cite the lack of trust as a critical factor underlying the divisive controversies that surround the management of technological hazards (e.g. Slovic, Flynn and Layman, 1991; van Ravenswaay, 1995; Siegrist, 2000). Numerous surveys point to the importance of trust in risk management and document the extreme distrust that lay people now have in many of the individuals, industries, and institutions responsible for risk management (e.g. Slovic et al, 1991; Flynn, Burns, Mertz, and Slovic, 1992). It has been suggested that the heart of risk perceptions and conflicts is not the issue of technological risk magnitudes, but rather trust in institutions (e.g. Wynne, 1980; van Ravenswaay, 1995).

If trust is a significant predictor of risk perceptions, it needs to be established what factors influence perceptions of trust. As this concept has been well researched, it is

addressed here only in a few words. A useful summary is provided by Renn et al (1991). Briefly, credibility is a precondition of trust and can be generated by (among other issues): good performance, fast responses to public requests, two-way communication, consonance with social values, highly focused information transfer, availability for communication, addressing of public expectations, and flexibility to respond to new demands (Renn et al, 1991).

Trust is a multidimensional concept and thus cannot be predicted by single items or psychological constructs in the absence of context. It is linked with perceptions of accuracy, knowledge, and concern with public welfare. People are adverse to ambiguous risks and trust is all the more important where there is a perception that accurate estimates of the risk are not available (Frewer, Howard, Hedderley, and Shepherd, 1996). While admitting to uncertainty could increase communicators' trustworthiness, the most important determinant of gain or loss of trust in a source is whether the information is subsequently proven right or wrong, and that the source is demonstrated to be unbiased (Frewer et al, 1996).

Thus the issue of trust has to be taken seriously. Trust is the crucial medium of exchange in society, with it, almost anything is possible, without it, almost nothing can be done (Luhmann, 1979). Trust is never granted as of right and cannot be demanded, rather it has to be earned in the course of a relationship (Luhmann, 1979). Therefore the creation of genuine expert-lay relationships is of paramount importance.

2.6.3 The role of the media

A further challenge to risk communication may be posed by the media which effectively 'mediates' between science and society. Although the exact influence of the media on public opinion is disputed (Hilgartner and Bosk, 1988; Gamson and Modigliani, 1989) the media is associated with various risk communication problems. For example by focusing on controversies among experts, public scepticism is heightened, increasing lay people's sense of risk (Mazur and Lee, 1993; Mol et al; 1993). The public is bombarded daily with media accounts describing new, previously unsuspected technological threats to human health and wellbeing (Hohenemser et al,

1982). By having ever increasing levels of expert knowledge relayed to them by the mass media, lay people are constantly surrounded by images and words which make them aware of risk (Joffe, 1999).

Apart from often being accused of covering risks in a biased or sensationalised way scientists and journalists both use explanatory devices to convey the meaning of their work (Kunreuther and Slovic, 2001). Science is about models, explanation, and representation, while journalists often resort to metaphors. Metaphor is not just a rhetorical flourish, but a basic property of language used to define experience and to evoke shared meanings (Layoff and Johnson, 1980). Nelkin (1987) regards the use of metaphors in science writing as particularly important in the explanation of technical detail, to define experience, to evoke shared meanings, and to allow individuals to construct elaborate concepts about public issues. Yet often, Schanne and Meier (1992) argue, journalism constructs a universe of its own, a 'media reality', which does not mirror actual reality.

Moreover, through the process of social amplification of risk the media is frequently an immense contributor to the development of stigma. As indicated in the previous chapter, social amplification can be triggered by the occurrence of an adverse event, and reflects the fact that the adverse impact of such an event can extend far beyond the direct damages to victims (Kunreuther et al, 2001). Extensive media coverage of an event can contribute to heightened perceptions of risk, as well as propagation of stigmatising images (Burns et al, 1993). Unfortunately, to date there is little research on the stigmatisation of technologies. However, we look at this concept in more detail when discussing the challenges of food risk communication in the following section.

2.7 Food risk communication

It can be argued that food risk may be a special issue for risk communication because a communication may need to address a range of important social dimensions not necessarily shared by other hazards. In the UK the case of GM foods may be a particular concern as the public has been sensitized to food risk since the BSE contro-

versy which contributed to lack of trust in regulators and communicators. In addition to (lack of) trust, as indicated in the previous chapter, at the heart of the GM controversy may be social and cultural issues such as values, often those related to “nature” in its broadest sense.

Moreover, food risk communication may prove particularly challenging because issues related to its social and moral significance need to be attended to. Although there have always been concerns with food ethics, modern agricultural and industrial practises can potentially result in ideological and societal conflicts on a much grander scale. For a traditional risk communication it might prove challenging to address these non-scientific issues.

2.7.1 The case of GM foods

In the UK the need for better risk communications between expert and lay people has become particularly apparent since the GM food controversy of the 1990s. Prior to the BSE scare, Britain was often cited as a country where expert opinions on risk issues enjoyed a great deal of public support (Jasanoff, 1995). After BSE, the British are among the most aggressive in opposing the production and distribution of GM foods (Jasanoff, 1997). Food scares such as BSE brought out national sensitivities and may have changed perceptions of food risk. Although this shift in attitudes cannot be definitely attributed to an increase in scepticism as a result of the BSE scare, it is consistent with the hypothesis that trust affects estimates of risk (Thompson, 1999).

Today, GM foods are the most rejected biotechnological application in all surveys (Wagner, Kronberger, Gaskell, Allum et al, 2001). This rejection has been described as the expression of a denunciation of the industrialisation and globalisation of food production, and a rediscovery of the social significance of food to healthy lifestyles (Wagner et al, 2001). The introduction of GM foods may have occurred at times of significant value changes in Europe and thus may be a surrogate for concerns emerging from other issues. The controversy over GM food served as a platform for many debates, such as the industrialisation of agriculture, the treatment of farmers and rural communities, and third world and equity issues. Especially in view of today’s abun-

dance of food in the west, GM food is widely regarded as unnecessary, even anti-cultural (Wagner et al, 2001). This indicates a social and societal basis of concerns over GM foods, and hence the need to incorporate broader factors than purely 'technical' risk dimensions in communication strategies.

Indeed, it is increasingly recognised that public concerns often focus on non-technical or intrinsic concerns, such as whether GM crops constitute a non-natural interference with nature, or whether they amount to "playing God" (INRA, 1993; 2000). The controversy surrounding GM can be regarded as moral insofar as it expresses a moral and ethical criticism of biotechnology, rather than a mere utilitarian concern solely in terms of safety and health. This presents a major challenge to risk communication based on the scientific facts of GM, and to date, from a rational science perspective such concerns are often still interpreted as making little sense (Macnaghten, 2004).

2.7.2 The particularities of food risk

With reference to the above, it needs to be questioned whether food in general may be a special issue in the way its risks are perceived. Many of the topical issues of food safety are likely to have features in common with other sorts of risks that have been subject to more detailed examinations. For example, the public's perception of the risks of GM food, share many of the features with the risk perceptions of nuclear power: both risks are perceived to be unknown and potentially catastrophic. But as well as certain commonalities, food risk perceptions have characteristics not shared by other hazard domains which may need to be acknowledged in a risk communication. These, it is argued, are related to its social and moral significance, and its potential for contagion and stigma.

2.7.3 The social significance of food

"Eating is one of the great sensual pleasures of life, the place where mystical at-oneness with the world meets, demystifies and celebrates biological necessity. ...Eating is more than bodily nourishment, a meal is more than food. ...Eating is an essential ingredient in our understanding

of ourselves, a literal coming to our senses. For this reason, eating is intimately bound up with our sense of being, individually and culturally.”

(Waltner-Toews, 1992; p.7)

With regards to Waltner-Toews' (1992) statement, it is not surprising that in many ways food presents a special application area for risk communication. The social significance of food has been apparent since Brillat-Savarin (1926) exclaimed: *“Tell me what you eat and I will tell you who you are.”*

This implies that food does not only have health-, energy-, and life-giving properties, but that it can also represent identities (Crouch and O'Neill, 2000). Eating is far more than nutrition (indeed in many ways nutrition may not be the most important aspect) and eating a meal is far more than “feeding”. From birth, food is a central part of life (Rozin, 1999). The great frequency of eating, the preparation of food, and the company of eating together render eating into a social and affective act (Rozin, 1999).

In the social domain, food is the center of family interaction around the dinner table, a means of welcoming others through hospitality, and a means of establishing ethnic identity and distinctiveness. Sharing food is one of the fundamental ways in which we can display, establish and maintain interpersonal intimacy (Rozin, 1999). Food is not “just food” as it is intimately bound up with social relations, including those of power, of inclusion and exclusion, as well as cultural ideas about classification, the human body and the meaning of health (Caplan, 1997). For instance, how and where we eat can reflect ideological and value commitments as well as our socialisation and status. Hence there are always individual and social contexts of eating that need to be considered as eating habits are a matter of culture, a product of codes of conduct and of the structure of social relationships (Murcott, 1983).

2.7.4 Food is a moral issue

Furthermore, eating can be a matter of morality. Commonly, there is an equation of nutritional with social values. For example, “eat up, it’s good for you”, connotes not only nutritional virtues but also that this is the right and proper way to behave (Murcott, 1983). Food becomes a moral entity in that what one eats, the past history and

preparation of one's foods, and the contexts in which they are eaten, become statements about one's worth (Rozin, 1999). Rozin proposes that today, after drug use and smoking have attained an immoral status, we now see the beginning of the moralisation of food indulgence, such as that eating junk food has negative moral implications.

Yet there has always been a moral concern with food, often reflecting religious and cultural values. For example, Jewish morality formed a distinction between what was allowed and what was disallowed. This dichotomy between legitimate and illicit food was developed through divine legislation. Thus the individual could acquire a distinct moral identity (Zwart, 2000). Here the idea developed that certain food products are to be regarded as contaminated in view of their origin, and that they are unlawful in themselves, not because they are actually unhealthy or tasteless. Hence rejected products are regarded as contaminated not in a literal but in a moral sense⁷.

Similarly, Douglas' (1966) suggests that the Jewish and Islamic categories, of clean (halal) and unclean (haram) bridge physical and logical aspects. For instance, fish with scales are halal, fish without haram, because fish without scales transgress an archetypal definition of fish. Rather than a measurable difference, the contradiction between the clean and unclean articulates inherent ontological contradictions between order and disorder, and in transcending boundaries of order these issues also signal risk (Douglas, 1966).

Therefore it would be mistaken to view all food prohibitions, such as the injunction in the Old Testament against eating pork, simply as forerunners of modern food regulations. Rather, such food prohibitions often served a variety of purposes, including the affirmation of ethical norms, distinguishing one group from another and symbolically bringing order into a chaotic world through classification (Johnson et al, 1987). Still today people's concerns and fears about different types of food risks can often be more accurately seen as ways of maintaining social and moral solidarity

⁷ For example, today adherents to vegetarianism regard meat products as contaminated, not because of health reasons but because they are made from animals. In that way it is a form of intrinsic contamination (Zwart, 2000).

rather than as solely reflecting health or environmental concerns (Johnson et al, 1987).

2.7.5 Challenges of modern agriculture

Whereas pre-modern food ethics often centred on issues relating to food consumption, contemporary food ethics tend to focus on issues relating to food production (Zwart, 2000). Significant changes in the system of food production, such as the introduction of pesticides or GM, produced a whole range of morally dubious and potentially risky new food products (Zwart, 2000).

Industrialisation affected the destruction of self-providing rural communities of the past, and greatly increased the distance between production and consumption of food (Zwart, 2000). This ever-increasing distance is both concealing and disquieting and raises the question of who can be trusted with the fundamental task of food production. Rather than being able to trace the source and quality of their food themselves, consumers have to depend on food producers, food providers and intricate labelling practices. Food today has materialised into industrial food products, with consumers acting only indirectly and from a distance on the systems of food production (Zwart, 2000).

This denaturalization of food products is contrasted with an ethically inspired counter-movement, such as consumer preference for green labels, organic food, and fair-trade products (Zwart, 2000) as well as advertising campaigns that cultivate the natural and organic and the image of the rural idyll, resulting in nostalgia for the 'good old days'. A common assumption is that what is natural is safe and healthy, and what is artificial or man-made is likely to be the opposite (Drottz-Sjoeberg, 1997).

Hence although the problem of adulteration of food stuffs has existed since centuries it seems that the present context of food production has made the problem unacceptable for the public and has fuelled a feeling of public indignation:

“For many people, the advent of new technologies rhymes with the disappearance of farmers and nature, both of which play quasi-mythical roles in the imaginary.”

(Bonny, 2000; p.289)

2.7.6 Contagion and stigmatisation

When comparing food risks to other risks, it appears that incorporations of dangerous substances into the body (such as through eating) have more a profound significance than many other types of behaviour involving risks (Rozin and Fallon, 1987). One of the reasons for this may be because eating involves an extremely intimate exchange between the environment and the self:

“The insulated, safe, self, protected by skin from the rest of the world, experiences a material breach of this boundary a few times every day in the act of eating. The world enters the self.”

(Rozin, 1999, p.14)

Hence it is not surprising that perceptions of contagion and stigmatisation are often particularly pronounced in relation to food. Rozin et al (1987) demonstrate that contagion results from short contact between a food and an object seen as disgusting. This is true even when the likely concentration of any toxic substance is known by the subject to be minimal, or even absent (such as from a sterilised insect). These responses are culturally transmitted, and there is evidence for learning such responses during childhood (Rozin, Fallon and Augustoni-Ziskind, 1985). The idea held by the public that there is no safe level of toxic chemicals in food (Kraus et al, 1990) may be related to these ideas of contamination and contagion. This implies a binary distinction between ‘safe’ and ‘unsafe’ in that the mere presence of these chemicals makes the food unsafe, no matter how small the concentrations (Sparks and Frewer, 1994).

Related to perceptions of contagion are perceptions of stigma. Stigma is based upon negative imagery that has become associated with places, products, technologies, and people (Kunreuther et al, 2001). For instance, at the time of the Alar scare, not only

were there huge losses in the US nation-wide apple market, but there was also a significant decrease in the Washington-state cherry market, even though the only link to the Alar application was one of geography (Gregory, Flynn and Slovic, 1995). Clearly, generalisations of increased perceived risk apply not only to related risks but also to unrelated risks (Johnson and Tversky, 1983).

Stigmatisation appears to share some conceptual overlap with the perceived risk or 'signal' value of a hazard. Signal value refers to the information that the hazard provides about future recurrence of the hazard (Slovic, Fischhoff and Lichtenstein, 1980). For example, it is thought that the occurrence of a low probability event, gives an indication that the hazard is out of control (Slovic, Lichtenstein and Fischhoff, 1984). In effect a stigma can be a warning marker, a way of communicating about risk, for instance to decrease the likelihood of taboo transgression (Walker, 2001). Hence stigmatisation is likely to play a role in relation to public resistance to a new technology. Looking at the governmental track record regarding BSE, public resistance to newer food-related technologies (such as GM) is unsurprising.

Although resistance⁸ is negatively connoted, it may function as an important signal that things are going wrong and as a call for action: "*To register resistance may be 'life serving' and secure the future*" (Bauer, 1995; p.404). Like stigmatisation, resistance is also a form of communication, pointing to the importance of certain issues that have to be dealt with immediately (Bauer, 1995).

2.7.7 Investigating food risk

Because of the socio-cultural particularities of food risk, it is evident that food risks have to be seen in their wider social and societal context. As food has a ubiquity of symbolic meanings food risk communication may be unique because of the rituals, mythologies, and cultural significance associated with eating.

⁸ Bauer uses the analogy of pain to explain the functions of resistance: "*Resistance affects socio-technical activity like acute pain affects individual processes: it is a signal that something is going wrong; it reallocates attention and enhances self-awareness; it evaluates ongoing activity; and it alters this activity in various ways to secure a sustainable future*" (Bauer, 1995; p.3).

Unfortunately, despite these idiosyncrasies, little research is specifically orientated to risk perception in the context of food production and consumption, despite the view that each hazard needs to be examined in its own right (Slovic et al, 1980). Only few scientific studies apply risk communication concepts especially to issues of food safety and green biotechnologies (exceptions are: Frewer, Howard, Hedderley, and Shepherd, 1996; Fischhoff and Downs, 1997; Sparks et al, 1994). Thus to date, an overall framework for risk communication involving food safety aspects including GM food is absent.

Hence Sparks et al (1994) suggest that an understanding of public perceptions of food risk is a pre-requisite for effective risk communication practise, and that an understanding of public perceptions of food risk requires well-executed empirical research actually addressing *food* risks. In light of this the present study looks explicitly at expert and lay GM food risk perceptions, with a view to offering some implications for risk communication.

2.8 Conclusions Chapter Two

In conclusion, it is evident that societal risk communication is still fraught with difficulties. In relation to food risk specifically, various socio-cultural and moral factors need to be better understood in order to be able to effectively communicate. Because of the importance of social factors in risk perception, Sjoeborg (2002) concludes that risk communication can no longer be construed as a question of providing scientific information alone. Rather:

“The theory of risk communication must be developed on a basis of differences in basic beliefs about nature and science.”

(Sjoeborg, 2002; p.12)

Although problematic, the move towards increased public participation in risk communication (as well as evaluation) has been argued to be the best solution, especially when dealing with post-normal risk, such as the risks of most novel high technologies. In many cases, information provision alone is inadequate, because of the inevi-

table gaps and uncertainties about how to evaluate risks. A clearer understanding of the scientific facts may allow a more focused debate but it may not resolve underlying philosophical disagreements (Granger Morgan et al, 2002). Thus an understanding of these non-scientific elements is of particular importance to risk communication efforts. To elucidate these disagreements a better understanding of how expert and lay people make sense of risk is vital.

3 MENTAL MODELS AND SOCIAL REPRESENTATIONS OF RISK

Following the examination of the challenges of risk perception and risk communication in the previous chapters, the present chapter introduces two frameworks, i.e. the mental model approach and social representations theory, which we utilise in order to explore expert and lay risk perceptions of GM food in depth.

The first part of the chapter introduces mental models, focusing on their application to risk communication. It is proposed that this approach can potentially improve risk communication design. Hereby, the focus is on the Carnegie Mellon University (CMU) approach, which provides part of the theoretical and methodological basis for the current thesis. Although offering a productive foundation for developing risk communication interventions, the CMU approach is criticised for some general as well as more specific shortcomings; in particular its individualistic orientation and lack of consideration for the origins of risk representations. It is argued that social representations theory (SRT) can alleviate some of these limitations.

Hence the second part of the chapter focuses on SRT, more specifically on how, in relation to risk perception and risk communication, this constructivist approach can supplement the cognitively orientated mental model approach. Although both approaches have thus far not been well connected they are not necessarily distinct. In essence, both approaches complement each other well as together they can highlight the complexity and the multi-dimensionality of risk.

3.1 An introduction to mental models

The beginnings of mental model research went hand in hand with the realisation that psychology could not rely on behaviour alone to investigate and explain human consciousness. As such, mental models offered a major critique to the prevalent behaviourism of the 1930s. Since that time there has been a growing interest in studying mental models in both the cognitive and the social sciences.

From the 1980's onwards the mental model approach has become a major research topic in cognitive psychology (e.g. Gentner and Stevens, 1983; Johnson-Laird, 1983; Rouse and Morris, 1986). Cognitive science proposes that thinking is the essence of mind and can be studied independently of other mental phenomena. Thus cognitive science largely ignores other mental phenomena such as moods, emotions, and consciousness (Cummins, 1989). Hence in agreement with Niewoehner (2001) the present thesis does not discuss this work in detail as it is rooted in a much more cognitive framework than the mental models used in risk communication.

Apart from cognitive science, sociology also uses various concepts that deal with stored representations in memory. Carley and Palmquist (1992) suggest that mental models are central to all theories in which individuals represent the world and interact with it through symbols, such as Mead's (1934) concept of the social object and the symbolic interactionists (e.g. Blumer, 1969), as well as in theories in which individuals construct the world, such as social constructivists (e.g. Berger and Luckmann, 1967). The assumption that language and communication are the keys to, and perhaps mediate the development of, mental models is not new (Carley et al, 1992). For example, Vygotsky (1962) and Luria (1978) argue that language mediates thought, thus affecting categorisation and behaviour to the extent that different social behaviours arise when language differs. With reference to the divergences in expert and lay risk discourse this latter point is particularly important for risk communication. Unfortunately, although sociology recognises the need for mental representations in social interactions, it has rarely studied this concept empirically.

In brief, it seems that on the one hand, cognitive psychology limits itself to issues of the mind as it functions within the individual, and thus studies mental models of the individual while neglecting the wider social context. Psychologists often pursue individuals' cognitive activities within a structural vacuum, ignoring the influence of the social environment (Morgan and Schwalbe, 1990). On the other hand, sociology examines the mental model in its various guises by focusing on social relationships but neglecting individual processes. This lack of connection between the cognitively and socially oriented disciplines indicates how the mental model history mirrors the conflict of the scientific paradigms. So far the different domains have not been well connected, although a convergence may offer a more complete representation of the ob-

ject under study. Acknowledging this shortcoming, the present thesis hopes to find a 'middle way' between both fields through a social psychological application of mental models to risk communication.

3.2 Conceptual clarifications

With reference to the diverse conceptualisations of mental models it needs to be questioned whether and how mental models differ from other postulated forms of mental representations. Often, it is disputed how the concept should be differentiated from that of knowledge in general. In many cases, the term mental model is simply used as a substitute for knowledge (Rouse et al, 1986).

Accordingly, a range of novel constructs have been developed to deal with knowledge structures of complex phenomena. Carley et al (1992) propose that the following approaches are all similar to mental models sharing their basic network orientation: conceptual structures (Sowa, 1984), schemes (Anderson and Bower, 1973), schemata or schemas (Fiske and Taylor, 1984; Tversky and Kahneman, 1988), frames (Minsky, 1975) and scripts (Schank and Abelson, 1977). Brewer and Nakamura (1984) argue that these are all examples of one general class of knowledge structure, i.e. mental structures that underlie various aspects of human knowledge and skill. All are frequently used to refer to the representational structures into which memory is organised. Despite having been applied in different scientific contexts, in essence, these concepts are comparable to mental models.

But there are surprisingly few explicit definitions of mental models. This most likely reflects the extent to which the concept has come to be acceptable on an almost intuitive basis (Rouse et al, 1986). In social science, the term mental model is often used metaphorically to describe a tool that enables researchers to acquire textual data from participants that can be used in various types of analyses. It is clearly distinguished from cognitive maps (e.g. Kearney and Kaplan, 1997; Tolman, 1948) as it does not make any claims about cognitive structures or neural networks (Niewoehner, 2001). This is the way in which the present thesis utilises the concept, as conclusions re-

garding neural structures and processing modes are not relevant to the objectives of the study.

Our aim is to explore expert and lay representations of GM food. Regarding risk perception, lay people generally lack complete understanding of a risk but still have at least some relevant beliefs about it, which they use in interpreting the related communication. To make inferences about the risk, such as how big it is, these fragmentary beliefs are assembled into a “mental model”, which in turn informs their conclusions (Granger Morgan et al, 2002). It is not a formal model, and does not involve strict mapping between things in the real world and elements in the model. However, it does share some functional features with formal models because people need to figure out which things in a complicated situation are worthy of attention, how these things interact with one another, and how well their abstractions capture the complexities of the actual processes (Granger Morgan et al, 2002).

3.2.1 The functions of mental models

Mental models can take many forms and serve many purposes, varying between scientific disciplines. But overall it is clear that mental models fulfil important roles in human reasoning and that they are essential for making sense of the world (Johnson-Laird, 1983). There is general agreement that mental models have three main purposes: describing, explaining and predicting. Clearly, understanding is a prerequisite for all those functions- if one does not understand something one cannot explain it. In turn, the psychological core of understanding requires people to have a ‘working model’ of the phenomenon in their minds (Johnson-Laird, 1983). Craik (1943) sums up:

“If the organisms carries a ‘small scale model’ of external reality and of its own possible actions within its head, it is able to try out various alternatives, conclude which is the best of them, react to future situations before they arise, utilise the knowledge of past events in dealing with the presence and future, and in every way to react in a much fuller, safer, and more competent manner to the emergencies which face it”.

(Craik, 1943; p.51)

In that way, mental models are necessary to enable people to think about things that are not present in the environment and to assess information related to the problem at hand (Kearney and Kaplan, 1997). Further, they may underlie an individual's ability to give a causal account of a particular domain, offering explanations and justifications (Williams, Holland and Stevens, 1983). Humans do not react merely physically to their environment, but rather seek to anticipate it (Johnson-Laird, 1983). Thus the simulation of a mental model generates the representation of a situation, whereby possible consequences of actions and events can be anticipated and possible preconditions of anticipated consequences can be identified (Jungermann, Schuetz and Thuring, 1988).

In order to serve these purposes, a mental model needs neither be wholly accurate nor correspond completely with what it models (Johnson-Laird, 1983). There may be no need for people to have a deeper understanding of particular issues because people can grasp the way they work without having to reduce everything to their fundamental principles. Hence the usefulness of a model is not necessarily increased by adding information to it beyond a certain level (Johnson-Laird, 1983). This implies that the value of a mental model needs to be judged relative to its particular functions and goals.

To sum up briefly:

“Mental models play a central and unifying role in representing objects, states of affairs, sequences of events, the way the world is, and the social and psychological actions of daily life. They enable individuals to make inferences and predictions, to understand phenomena, to decide what action to take and to control its execution, and above all to experience events by proxy; they allow language to be used to create representations comparable to those deriving from direct acquaintance of the world; and they relate words to the world by way of conception and perception.”

(Johnson-Laird, 1983; p.397)

3.3 Mental models in risk communication

Since mental models guide people's perceptions, decisions, and behaviour (Kearney et al, 1997), they can aid in understanding how people perceive problems, in determining how information may be most effectively shared, and in designing strategies for behavioural change. These are some of the reasons why the application of mental models has become increasingly popular in risk communication. However, so far, the approach has largely focused on privately managed hazards, rather than societal risks. Johnson (1993) argues that there is a need to change focus. The study of GM food offers a case in point, and it is hoped that the present research may help to alleviate this shortcoming.

Previous chapters have shown that there is a heightened awareness of technological risk and a need to improve risk communication efforts. To make the process of risk management more amenable to public involvement better models of how the language of risk assessment is understood by the public as compared to the expert community need to be developed (MacGregor, Slovic and Malmfors, 1999). Mental model theory is one of the most promising recent developments as it can show how individuals understand risk. The following section outlines the benefits of the mental model approach to risk communication, before looking at the (Carnegie Mellon University) CMU approach in detail as it provides the partial foundation for the present study. Lastly, the CMU approach is criticised on several points, which leads into a discussion of why the present study complements this approach with social representations theory.

3.3.1 Benefits of mental models for risk communication

As discussed in Chapter Two, a major problem in developing risk communications is determining the exact content. A deeper understanding of expert and lay risk perceptions can indicate what a message should or should not contain, and how best to design and present a communication. The application of the mental model technique to risk communication can potentially help to answer these vital questions.

Risk communication efforts often fail because information is not relevant enough to the audience in the particular context (Granger Morgan, Fischhoff, Bostrum and At-

man, 2002). Based on findings from mental models research and text comprehension studies Atman, Bostrum, Fischhoff et al (1994) show that inappropriate content and poor structure are likely to confuse communication recipients. It is difficult to decide what risk information needs to be presented and how extensive this information should be. Understanding people's mental models may aid these decisions.

Effective risk communication must focus on the things that people need to know but do not know already- this seemingly simple norm is violated remarkably often (Granger Morgan et al, 2002). Rather than analysing what the public believes and what information they need to make the decisions they face, often communicators ask technical experts what they think people should be told (Granger Morgan et al, 2002). As a result, the needs of the intended audience may be neglected. Under such conditions it is not surprising that audiences frequently misunderstand (Granger Morgan et al, 2002).

Hence in order to educate the public, policy makers must start by educating themselves about what lay people already know and believe and how it might differ from what they need to know to make effective decisions, as one cannot necessarily trust technical experts' intuitions about public beliefs (Fischhoff, Slovic and Lichtenstein, 1982).

Therefore, a major task of mental model approaches to risk communication is to determine what lay people currently believe about an issue so that information whose provision would have the greatest impact on recipients' ability to make decisions in their best interests could be identified (Granger Morgan et al, 2002). Yet often studies focus not so much on what people know about a given topic or on how they use their knowledge but rather on what people do not know, i.e. gaps in their knowledge (e.g. Gamba and Oskamp, 1994; Syme, Beven and Sumner, 1993). However, it also needs to be determined whether the gaps are actually worth filling, i.e. are there any important decisions or substantive inferences that hinge on this knowledge? If not, then unease over this display of "ignorance" could be doubly damaging (Bostrum, Fischhoff and Granger Morgan, 1992). While on the one hand, it would unnecessarily erode experts' respect for lay people, on the other hand, it would waste the pub-

lic's valuable attention by focusing communications on irrelevancies, perhaps eroding public respect for experts (Bostrum et al, 1992).

Thus the identification of knowledge gaps by itself does not provide sufficient direction for devising communications. Rather, it is also important to consider an individual's existing mental model of the issue. As communication never involves filling a 'tabula rasa' the availability of prior knowledge presents the basis for gaining new knowledge as prior knowledge almost certainly affects learning (Glaser, 1984). Although existing knowledge offers a foundation on which to build, it can also be an obstacle (Rouse et al, 1986). Prior knowledge that is incorrect will not necessarily be discarded once the correct knowledge is provided (Rouse et al, 1986). Instead, an amalgam of the correct and incorrect may be retained, especially if the incorrect aspects are such that everyday life experiences are unlikely to yield any inconsistencies (Rouse et al, 1986). Hence, mapping current knowledge is an essential part of improving risk communication design and numerous studies show success of this (e.g. Atman et al, 1994; Bostrum et al, 1994; Kearney et al, 1997).

In sum, because information provided does not equal information received effective communication requires an understanding of people's existing mental models so that information can be framed in a way that encourages people to notice and integrate the new information rather than ignore and re-interpret it. The mental model approach has the potential to solve these problems, as assessments of lay mental models can contribute important new input to decision making and problem-solving processes (Kearney et al, 1997). In turn, further integration of lay knowledge in the decision making process may facilitate wider acceptance of the solutions that are finally reached (Kearney et al, 1997).

3.3.2 The Carnegie Mellon University approach to risk communication

From the different mental model approaches, the present thesis utilises the Carnegie Mellon University (CMU) approach to risk communication developed by Granger Morgan et al (2002). This is a pragmatically well developed approach, and provides a number of clear guidelines for risk communication design. By addressing prior misconceptions as well as providing correct knowledge the CMU approach offers a po-

tential solution to the risk message and communication problems outlined in Chapter Two.

The approach suggests that communication failures reflect the lack of systematic procedures for finding out what people know and need to know, and for confirming empirically that a communication has been effective. Hence the CMU approach consists of a five-step method for creating and testing risk messages as shown in table 3.1. Briefly, before disseminating a risk message, communicators must characterise expert knowledge about the risk, study current expert and lay beliefs, examine the risk decisions that people face, develop a communication focused on critical content, and evaluate the message through empirical testing (Granger Morgan et al, 2002). The present study focuses solely on steps 1 and 2 aiming to establish expert and lay mental models of GM food risk.

Table 3.1 *The CMU Methodology* (adapted from Granger Morgan et al, 2002; pp. 20-21).

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1. *Create an expert model.* Review and summarise the current scientific knowledge about the risk. The formal representation may be an influence diagram, a directed network drawn from decision theory, which allows representing and interpreting the knowledge of experts from diverse disciplines. The term 'expert' refers to the individuals creating it, without implying that their beliefs are superior to lay beliefs. What experts believe about a risk provides one basis for determining what lay people need to know. These beliefs can be summarised in influence diagrams, a formulation that allows (a) integrating diverse forms of expertise and (b) assessing the importance of different facts. The objective is to construct a single description, summarising the pooled knowledge of the community of experts, not the views of any one expert.
 2. *Conduct mental models interviews.* Utilise open-ended interviews to elicit people's beliefs about the hazard, expressed in their own terms. The interview protocol is shaped by the influence diagram. The responses are analysed in terms of how well mental models correspond to expert model captured in influence diagram.
 3. *Conduct structured initial interviews.* Create a confirmatory questionnaire whose items capture the beliefs expressed in the open-ended interviews and the expert model. Administer this questionnaire to larger groups of the intended audience, in order to estimate the population prevalence of these beliefs.
 4. *Draft risk communication.* Use the results from the interview and questionnaires, along with an analysis of the decisions people face, to determine which incorrect beliefs most need correcting and which knowledge gaps most need filling. Then draft the communication and subject it to expert review to ensure its accuracy.
 5. *Evaluate communication.* Test and refine the communication with individuals selected from the target population, using one-on-one read-aloud interviews, focus groups, closed-form questionnaires, or problem-solving tasks. Repeat this process until the communication is understood as intended.
-

In essence, the goal of the CMU approach is to create an adequate mental model of the risky process, allowing people to know which facts are relevant and how they fit together. In this way, it is a more public-centred framework to developing risk messages than traditional risk communication approaches, as it assumes that the principal

obstacles to understanding are lay time and attention, not intelligence (Granger Morgan et al, 2002). The CMU approach adheres to three tenets. First, the audience needs to be offered a basic understanding of the exposure, effects, and mitigation processes relevant to making decisions about the hazard. Second, existing audience beliefs are assumed to affect reception and interpretations of any new information. Third, new information must be represented in such a way as to be consistent with the levels of understanding that is manifest in the audience (Breakwell, 2001). Breakwell proposes that:

“This approach is possibly the most productive basis for developing risk communication interventions. It seeks to identify for a particular hazard both accurate and inaccurate beliefs that are held by a target population. Mental models are then used as the basis for developing risk communication material that will correct misunderstandings. In this approach, the goal is to bridge the gap between lay and expert models of the risk by adding missing concepts, correcting mistakes, strengthening correct beliefs and minimising peripheral ones”.

(Breakwell, 2001; p.341)

3.3.3 Influence diagrams

It should be noted that, to date, the actual construction of mental models in general is not a well-defined technique- clear methodological guidelines tend to be lacking. As shown in table 3.1, steps 1 and 2 of the CMU approach comprise the construction of expert and lay mental models in the form of influence diagrams. Since this is not a widely used technique in social psychology it is explained in some detail here.

In accordance with Granger Morgan et al (2002), the present thesis represents expert and lay mental models through influence diagrams. Influence diagrams were developed by decision-analysts as a way to summarise information about uncertain decision situations, allowing effective communication between experts and decision-makers and the conduct of information-related analyses. An influence diagram is a directed graph, with arrows or ‘influences’ connecting related nodes. It can be thought of as a snapshot of all the factors that influence the state of the world, including the decisions that can trigger or shape the processes captured in the nodes. Many nodes can be involved simultaneously and involve uncertain outcomes, so that the

outcome is unknown until the process has played itself out. Being able to incorporate both causal and non-causal relationships allows influence diagrams to accommodate all available information (Granger Morgan et al, 2002).

By imposing a few structural rules, attaching actual mathematical relationships to the influences and describing the value of the uncertain variables in terms of probability distributions, influence diagrams can be given very precise meaning and be converted into a decision tree. However, the present thesis uses influence diagrams more heuristically, showing which factors matter and how they are interrelated⁹. After the transcription and the coding of the interview data, we investigate the co-occurrences of codes and then graphically map the relationships between them. The procedure for our development of expert and lay mental models of GM food risk is explained in more detail in the relevant chapter (Chapter Six).

3.3.4 An empirical application of the Carnegie Mellon University approach

The CMU approach as described above has been used to investigate a variety of risks, such as risk perceptions of smoking (Niewoehner, 2002), and helped to set the agenda for public health risk campaigns about HIV and sexual behaviour (Carnegie Mellon Aids Group, 1997). To date, the approach has not yet been applied to examine risk perceptions of biotechnologies, or more specifically, GM foods. Because the CMU approach is so central to the present thesis we illustrate the application of this approach by looking at research conducted by Bostrum, Granger Morgan, Fischhoff and Read (1994) on another societal risk, namely climate change. In line with the CMU approach, Bostrum et al characterised public understanding of climate change, aiming to comprehend the public's literacy about the topic.

Based on expert knowledge, and following the steps of the CMU approach as outlined in table 3.1, lay people were asked what they know about definitions, exposure and effects of climate change. The results indicated that even well-educated lay people conceptualise climate change issues very differently to technical specialists. For example, lay mental models of climate change focused more on CFCs than carbon

⁹ For Granger Morgan et al (2002) the goal of constructing an expert model is achieving sufficient clarity that the influence diagram could be converted into an executable computer model. This is not necessarily the objective of this thesis.

dioxide or energy use, and frequently omitted the latter. Fundamental inconsistencies were often based on confusion of the greenhouse effect with ozone depletion, as well as other relatively basic terms. Commonly, people simply equated the greenhouse effect with global warming and were unaware of the underlying mechanisms and causes. Rather than mentioning the production of electricity as a cause of global warming, far more respondents believed that space exploration was the cause, with some believing that spacecrafts punch holes in the ozone layer¹⁰.

Thus the findings showed that in order to succeed, a risk communication about climate change would need to address a range of issues that differ significantly from expert assessments of the risk (Bostrum et al, 1994). Essentially, the application of the CMU approach to climate change risk illustrated the pervasive influence of basic misconceptions, and in turn, their potential to influence judgements and decision making.

Although most respondents believed climate change to be a threat and favoured action to address it, it was clear that their mental models restricted their ability to distinguish between effective and ineffective strategies. For instance, results showed that lay people may waste their energies on fairly ineffective actions such as refusing to use spray cans, while neglecting more critical strategies such as energy conservation. Further, apart from potentially mis-directing the public's support for proposed policies, some of these misunderstandings may leave the public vulnerable to manipulation of interest groups (Read, Bostrum, Granger Morgan, Fischhoff and Smuts, 1994).

In sum, by utilising the CMU approach and allowing respondents to structure and define their own responses, Bostrum et al (1994) showed how people conceptualise and describe issues about climate change. In this way, the empirical assessment of what lay people already know together with a scientific determination of what people actually need to know about this risk was shown to be an important foundation for the design of relevant risk communications.

¹⁰ One respondent suggested that NASA consider launching through a single hole, so as to avoid making new ones.

Read et al (1994) followed up the mental model interviews above with a structured questionnaire to give a more precise indication of the frequency of beliefs observed by Bostrum et al (1994), essentially following the third step of the CMU approach as outlined in table 3.1. The findings largely confirmed the prior qualitative results highlighting the potential usefulness of the CMU approach to risk communication about climate change.

3.3.5 Reflections on the Carnegie Mellon University approach

The above example indicates that the CMU approach can potentially offer a theoretically integrated and empirically testable set of easily used risk communication design and evaluation methods. To some extent, the CMU approach agrees well with the ‘third way’ of risk assessment discussed in Chapter One. Like other risk communication approaches, it is committed to the scientific facts of risk and to their empirical investigation, but stresses the need for openness in communication about risk and the importance of public perception and involvement (Granger Morgan et al, 2002).

According to Granger Morgan et al, the CMU approach provides a way to identify, avoid, and evaluate the pitfalls of irrelevant or poorly structured and understood risk communication by evaluating both expert and lay perspectives. It ensures that, if they choose to, lay people can understand how the risks they face are created and controlled, how well science understands these risks and how great they seem to be (Granger Morgan et al, 2002).

By listening to the public’s concerns before designing communications, and by addressing misconceptions held by the public, the CMU approach can help to ensure that the information provided is relevant. This would alleviate at least some of the message and communication problems outlined in the previous chapter.

Developing effective risk communication can be time-consuming and expensive. The successful application of the CMU methodology can take up to one year (Granger Morgan et al, 2002). But Granger Morgan et al insist that it is certainly worth it, especially when considering the potential health (and economic) consequences of misunderstanding risks. Properly used the methods described can help to develop clear

and understandable risk messages (Granger Morgan et al, 2002). The availability of such messages is an important element in the process of risk communication and management. But while such messages are important, Granger Morgan et al admit that they are only part of what is needed for a more democratic management of risk in society.

3.4 A critique of mental models

Although potentially useful for improving risk communications, the CMU approach can be criticised in relation to several general mental model research limitations. Because of its particular concern for risk communication research our focus is on the individualistic orientation of mental models and their lack of consideration for the (social) origins of risk representations, which leads into a discussion of why, for the present thesis, the approach is synthesised with social representations theory (SRT).

3.4.1 Biases of mental models of risk

One of the limitations of mental models is fundamental to science in general. Scientists' conceptualisations of others' mental models are dependent on their own models. These dictate what observations are made and how the resulting data is organised. The ultimate subjectivity and arbitrariness of this process has long been recognised (e.g. James, 1909). The problem of subjectivity is aggravated in the study of mental models because such studies amount to one or more persons developing studies of others' models of the external world (Cohen and Murphy, 1984). In essence, our conceptualisation of others' mental model of a risk is basically a "*model of a model*" (Norman, 1983; p.9).

Thus it needs to be recognised that the conceptualisations chosen by researchers reflect their methodological backgrounds and the way in which they assume humans are likely to view the issue (Norman, 1983). This of course is fraught with opportunities to misinterpret observations and bias descriptions, as it can be difficult to get away from the fundamental assumptions of one's own cultural tradition. Yet the fail-

ure to appreciate the utility of others' mental models may cheat us out of important insights (Hutchins, 1983).

This implies that expert as well as lay mental models of a risk have to be taken seriously and treated as valid. However, one of the major problems of the CMU approach is that it has a strong bias towards the scientific perspective- any deviations from it are seen as major problems and as 'errors' requiring correction. Therefore, although it can be credited with outlining lay views in addition to those of the experts, essentially the CMU approach is still a top-down approach. Because it aims to bring lay views in line with those of the experts rather than explore the utility of lay views, it implies that the former are less legitimate representations of the risk in question.

But looking at nuclear power for example, it is evident that lay people do not merely process information according to the hard facts of science. Rather nuclear power is a highly emotive issue, for example in relation to environmental destruction and fear of catastrophes (Joffe, 2003). As such, the symbol-laden response to nuclear power (for example symbols of scientific and technological hubris) is as legitimate as the scientific perception of it, rather than a deviation from objective reality (Joffe, 2003). This recognition is important in order to represent a risk in all its complexity. In turn, this implies that the CMU approach would benefit from being complemented with an approach that can better account for the non-scientific risk dimensions of a risk.

3.4.2 Completeness and accessibility of mental models of risk

Beyond limits imposed by researchers' biases, there are difficulties in uncovering people's mental models because "*the 'black box' of human mental models will never be completely transparent*" (Rouse et al, 1986; p.349). Entirely capturing a mental model is difficult, because they are dynamic entities that have a multiplicity of forms even for a particular individual in a specific situation (Jungermann et al, 1988; Rouse et al, 1986).

Also, apart from incompleteness discovering what a person's mental model is like is difficult because all of a person's belief structures may not be available to inspection

(Johnson, 1993). But in agreement with Rouse et al (1986) the present thesis argues that mental model research should focus on its practical aims. We take a more pragmatic view by considering its uses for risk communication. Completeness is less of a problem when taking a functionalist perspective as in the present study. Lay people's mental models of a risk do not need to be complete or consistent for them to be effective, a reasonable large and coherent interconnected set of facts and hypotheses can be workable and robust (Kahnemann, Slovic and Tversky, 1982).

3.4.3 The individualistic orientation of mental models of risk

However, a significant shortcoming of the mental model approach is its individualistic orientation. Because of the cognitive research tradition to date and the subsequent neglect of the social context of beliefs, explanations regarding the development and the origins of mental models focus solely on individual information processing.

By focusing on an individual's cognitive processing the CMU approach essentially overlooks how social processes may confirm or alter initial interpretations of events. The dynamics, by which the patterns and contents of risk representations are acquired and maintained, are mostly ignored. As such, the mental model approach takes the world as a given, rather than as partly a social construct. This may be especially problematic for the study of risk, which as previous chapters indicate, is at least in part, socially constructed.

Hence the CMU approach cannot explain how mental models of a risk actually emerge. Despite a broad range of empirical studies the issue of how exactly individuals come to think of the world in a particular way has largely been neglected (an exception is Breakwell, 2001). Some mental models are highly artificial and acquired only by deliberate cultural training, e.g. models governing domains of pure mathematics. Others are natural, acquired without explicit instruction, and used by 'everyone' (Johnson-Laird, 1983). This latter point hints at some social or cultural construction of mental models, but Johnson-Laird does not offer any further detail.

Mental models are constructed when we make inferences that can be either explicit requiring conscious effort, or implicit, outside conscious awareness (Johnson-Laird,

1983). This distinction between explicit and implicit inferences suggests that we must also consider the conditions under which inferences are made. When suggesting that some of those are *outside* conscious awareness, Johnson-Laird (1983) indicates the importance of considering the situational and socio-cultural contexts. As the true creator of an idea is not the individual but the thought collective¹¹ (Fleck, 1935), it is unlikely that the creator of a mental model is the individual rather than society.

Yet it is a long-standing problem in social psychology that explanations and hence interventions are often focused at the individual failing to recognise that people's views are located and legitimised within social groups. Lewin (1958) already showed in his paper on changing food preferences that it is difficult to change attitudes by working on individual attitudes alone. Rather, attitudinal change is far more likely when the social context is incorporated as representations are often the outcome of group processes. Thus if risk representations are indeed the outcome of group processes and legitimised as such then one needs to address the normative frameworks that lie behind expressed attitudes. In that respect, the CMU approach is lacking, indeed it can be argued that it is a socially deficient model as it focuses on the individual in isolation, neglecting the social context of risk perception and risk communication.

3.5 Utilising SRT to complement the mental model approach

"The greatest error of individualistic psychology is the assumption that a person thinks. This leads to a continual search for the source of thought within the individual himself and for the reasons why he thinks in a particular way and not in any other. What actually thinks within a person is not the individual himself but his social community. The source of his thinking is not within himself but is to be found in his social environment and in the very social atmosphere he 'breathes'."

(Gumplowicz, 1905; p.46 *op cit*)

¹¹ Fleck suggests that "if we define 'thought collective' as a community of persons mutually exchanging ideas or maintaining intellectual interaction, we will find by implication that it also provides the special 'carrier' for the historical development of any field of thought, as well as for the given stock of knowledge and level of culture. This we have designated thought style" (Fleck, 1935; p.39).

Gumprowicz's (1905) quote above indicates the importance of incorporating the social context when investigating risk representations. Cognitively orientated approaches (such as the CMU approach) are practical to develop efficient and possibly predictive models. Yet although they can clarify how individuals think and act in various circumstances cognitive approaches are insufficient because of their lack of concern about supra-individual dynamics (i.e. cultural, social, and ideological dynamics). Lorenzi-Cioldi (2000) argues that this focus on individual models has distracted researchers from studying the conditions that facilitate, hinder or moderate the implementation of cognitive principles. The individual appears to be simply an information processor according to certain mechanical rules. Hence a socially orientated approach is required to explain why and when such general cognitive principles are activated and applied in social reality. In this respect

“Molecular approaches to social cognition and more comprehensive approaches to social representations complement one another.”

(Lorenzi-Cioldi, 2000; p.220)

Thinking is always 'situated' and can therefore only be fully understood by taking the situation into account (Lave, 1988). Hence for the present research we choose to supplement the CMU approach with social representations theory (SRT). Following the discussion of the limitations of the CMU approach above, the following sections outline how SRT can alleviate some of these shortcomings.

3.5.1 Defining social representations

Moscovici (1963) defines social representations as *“the elaborating of a social object by the community for the purpose of behaving and communicating”* and as a socially determined *“universe of opinions”* (Moscovici, 1963; p.xiii). Although Moscovici's use of the term social representation has been criticised as lacking a clear operational meaning (Hammond, 1993), the common theme of various definitions is the existence of some form of a shared ideation across a group.

The key point is that social representations constitute *collective* systems of meaning which may be expressed, or whose effects may be observed in values, ideas and

practises (Duveen and Lloyd, 1993). In short, social representations are more than a system of images inherited from culture rather they can be regarded as the result of a given group's confrontation of the objects in its environment with its social reference criteria (Kaes, 1968). A group's social representations of an object are a complex product of available information about that object and attitudes towards it¹². Because they are the shared affective property of a group, rather than the mental property of isolated individuals, they are *social* representations (Morgan and Schwalbe, 1990).

In turn, SRT obliges the researcher to move beyond the notions of a generic information processor as implied by the mental model approach to the social contexts of beliefs in which individuals live and interact. This is achieved by pointing to factors that determine the content of representations, facilitate their emergence, activation, and use (Lorenzi-Cioldi, 2000). In this way, SRT shifts the theoretical focus from the formal properties of individuals' mental models to the properties of the surrounding social context (Lorenzi-Cioldi, 2000). By incorporating this wider context, mental models are "socialised" turning them into social representations.

3.5.2 "The thinking society"

Representations are social in at least three senses. Firstly, they are linked to communication processes, most importantly, unstructured everyday talk (Moscovici, 1984). Secondly, social representations are social because they provide a way of distinguishing between social groups. Thus they are a unifying and homogenising force; and indeed, sharing a common representation may be the very thing that makes groups what they are (McKinlay, Potter and Wetherell, 1993). Thirdly, social representations provide an agreed code for communication. To the extent to which people share a representation, they will understand each other and be able to have fluid and intelligible conversations (McKinlay et al, 1993).

¹² More formally, a social representation can be characterised as the relation between three elements: 1) Subjects or carriers of the representation, 2) An object that is represented, a concrete entity or abstract idea, and 3) A project or pragmatic context, of a social group within which the representation makes sense (For a more detailed discussion, please see Bauer and Gaskell, 1999).

In SRT, the social and the individual are not seen as opposed universes, but rather is the social seen as a product of communication and interaction between individual minds culminating in “the thinking society” (Gaskell, 2001). Although the conception that society does not think prevails, it is evident that individuals and groups are not simply passive receptors, but think for themselves, and produce and communicate their own specific representations (Moscovici, 1984).

Thus social representations have a dual existence as both product and process. First, they are the product of social thinking, structuring beliefs and knowledge about phenomena considered significant for a coherent community (Philogene and Deaux, 2001). Second, they are the processes by which people construct reality, shape their thoughts and talk about events and objects (Philogene et al, 2001). Hence they are the products of interconnectedness between people and the processes of references through which we conceive the world (Philogene et al, 2001), allowing us to make sense of the world and communicate that sense to each other (Moscovici, 1984).

In brief, representations are social creations, and as such, part of social reality. When contemplating individuals and objects, inherited genetic predispositions, learned habits, preserved memories and cultural categories all combine to make them as we see them (Moscovici, 1984). They arise through communication and interaction, rather than being an individual construct. As a result of the conceptual mediation between the social and individual (Wagner, 1994), and the recognition of the importance of our social reality, SRT may help to “socialise” the individual in psychology.

3.6 Benefits of social representations theory for risk communication

In relation to risk communication the advantages of utilising both SRT and the mental model approach are evident. To begin with SRT explicitly aims to understand common sense knowledge rather than perceiving lay perceptions as “deviant”. As a result, the theory may offer an alternative to the information-deficit model. Furthermore, by appreciating the social context of beliefs SRT may also help to shed light on the origins of risk representations.

3.6.1 Understanding common sense

In its present form, social representations research was initiated in the late 1950's with Moscovici's investigation into what French men and women thought about psychoanalysis (Moscovici, 1961). In essence, Moscovici wished to understand what happens when a scientific theory becomes represented and absorbed into common knowledge. Common sense is continually being created in society, especially when scientific and technical knowledge is popularised (Moscovici, 1984).

Consequently SRT has been specifically developed for the study of lay knowledge (Moscovici, 1976). Hence a distinct advantage of SRT over the mental model approach is that it explicitly aims to understand the productions, structures and functions of common sense (Bauer and Gaskell, 1999). Thus in contrast to the mental model approach which focuses on individual cognitive processes and their limitations, SRT emphasises meaning-making and the complexity of common-sense thinking. Social representations are recognised as being more than purely cognitive or scientific constructs. Rather, they have affective and prescriptive functions, and are likely to be dynamic and continually changing (Gaskell and Fraser, 1990). Thus utilising SRT for risk perception research means looking at how lay people make sense of a risk rather than focusing on the scientific aspects of the risk alone.

3.6.2 The reified and consensual universes

Moscovici (1976) distinguishes between the 'sacred' sphere of science and the 'profane' sphere of ordinary life, and refers to these as different worlds of meaning as the reified and consensual universes. The sciences are the means by which people understand the reified universe, while social representations deal with the consensual.

The worst crisis occurs when tensions between consensual and reified universes create a rift between scientific and common sensical knowledge (Moscovici, 1984). In relation to risk, competing expert and lay representations are common- hence risk in general is excellent territory for contested social representations (Breakwell, 2001).

Moreover, Moscovici (1984) proposes that the character of social representations is revealed particularly in times of crisis and upheaval when new concerns arise for dif-

ferent groups. When a group or its images are undergoing a change people are more willing to talk and images and expressions are livelier (Moscovici, 1984). Therefore, SRT is especially relevant for describing and understanding 'hot' social issues, i.e. social objects in the making or in rapid change, such as biotechnology (Gaskell, 2001).

Since science has transformed, and will likely continue to transform, life as we know it today, it is important to study the social representations of science (Farr, 1993a). Indeed, Farr argues that the study of social representations is a form of social science that natural scientists need to take seriously if their advice to governments is to become more effective (Farr, 1993a). It is challenging if the consensual and reified universes are "worlds apart" as this inhibits any communication between both spheres (Farr, 1993a). With regards to risk communication, if scientists ignore lay representations they may find that the consequences of the advice they offer governments is not what they intended (Farr, 1993a).

3.6.3 An alternative to the information-deficit model

Past societal risk communication failures have shown that communications based on the information-deficit model are often insufficient to alleviate lay concerns. Yet in a sense the CMU approach is still a version of the information-deficit model because it regards lay risk perceptions as (potentially) incorrect beliefs that need to be corrected through the provision of more scientific information.

In contrast, having been especially developed for the study of common sense, SRT appreciates that lay perceptions are not inherently faulty and instead regards them as the common sense response to the challenges posed by the experts (Bauer et al, 1999). Hence lay perceptions are not interpreted as false or biased representations of the experts' understanding, but rather recognised as a reality of their own. This means that plural risk responses are possible, and that there is not one right and one wrong response as implied by CMU approach.

While lay people's risk representations may be an irritation to experts, their emergence, collection, description and functional analysis is one of the potential contribu-

tions of SRT to the CMU approach. Thus SRT is a public-centred bottom-up rather than expert-orientated top-down approach. By recognising the social correctness¹³ of lay knowledge, SRT may offer an alternative to the often criticised information-deficit model.

3.6.4 The origins of risk representations

Rather than individualist assumptions common in the traditional risk literature, whereby human thoughts are studied as if they arise within and reside exclusively inside individual minds, SRT proposes that human thought is relational at root (Joffe, 2003). Thus in contrast to the mental model approach, this framework appreciates that representations are not constructed within individual minds but that they emerge within society, within interpersonal communication, the mass media and social, political and cultural institutions.

In particular, SRT is concerned with how new knowledge changes as it is transformed from the reified into the consensual sphere. Often, it is through the media that lay people are first confronted with novel scientific information, such as information about risk. Thus the media likely play a major role in the development of social representations of a risk as it means that representations are communicated between people and thus enter their thoughts and explanations of new events (Joffe, 2003).

Regarding biotechnology, many of its scientific aspects are incomprehensible to the untrained person. Since most people do not have the time to follow detailed expert discussions or read scientific journals, the majority relies on media reporting and personal conversations (Bauer et al, 1999). In this way, biotechnology becomes a reality through images, metaphors, and so on. Resulting representations give shape to the public's understanding and define the characteristics of the social object "biotechnology" (Gaskell, 2001).

¹³ Habermas (1973) argues that images and beliefs can be socially true- even when incorrect in the sense of scientific truth- when they are "good to think", i.e. when their meanings are well embedded in a group's local world of experience, and their symbolisms appeal to the group's dominant aesthetic sentiments. If images and associated beliefs are good to think, they are said to be socially true.

SRT appreciates that a re-presentation of biotechnology is not a final outcome but rather a process that is essentially socially generated and sustained, resulting in a number of realities of biotechnology in the public sphere (Gaskell, 2001) because far from being passive receivers of media presentations lay people actively forge representations in line with their concerns. By analysing the different representations of biotechnology underlying diverse positions, it can be documented how and under what conditions social representations enable, constrain or change the trajectory of biotechnology (Bauer et al, 1999), an understanding of which is of major importance for the development of better risk communications.

3.6.5 Familiarising the unfamiliar

More specifically, SRT suggests two major processes of how (generally unfamiliar) scientific knowledge becomes familiarised and of how lay people may make sense of a novel risk: anchoring and objectification.

Anchoring involves the naming and classifying of novel encounters, ideas, things, or persons based on an existing order of meaningful names (Moscovici, 1984). It draws something foreign into our particular system of categories and compares it to the paradigm of a category, which is thought to be suitable. Insofar as a given object or idea is compared to the paradigm of a category it acquires the characteristics of that category and is re-adjusted to fit within it. Even when aware of a certain discrepancy, of the approximation of our assessment we cling to it to preserve a minimum of coherence between the unknown and the known (Moscovici, 1984).

Objectification is a far more active process than anchoring. It solidifies and makes tangible the abstract new idea, turning the idea of unfamiliarity into the essence of reality. Every representation realises a different level of reality. These levels are created and maintained by a collectivity and vanish with it, having no reality of their own (Moscovici, 1984). In the process of objectification an icon, metaphor or trope is constructed which comes to stand for the new phenomenon or idea. The choice of icon, etc. is not arbitrary but related to culture (Wagner and Kronberger, 2001). This is shown in Jodelet's (1991) study where French lay subjects (villagers and farmers) talked about mental illness in terms of 'decay', or 'curdling' like butter. As such so-

cial and cultural conditions of certain groups favour specific kinds of trope to represent and familiarise an unfamiliar phenomenon. Thus group differences may be sociostructural, historical, cultural, subcultural, educational, and so on (Wagner et al, 2001).

It should be noted that anchors and objects are not wholly fixed rather they are transitional pointers in the evolution of meaning of an aspect of the world (Moscovici, 1984). Also, it is implicit in the notion of anchoring that a social representation of one target relates to that of another. Unfortunately, empirically, the problem lies in knowing when one finishes and another begins. This decision may be arbitrary, and as in mental model research there are no clear criteria which, once satisfied, ensure that the representation has been catalogued (Breakwell and Canter, 1993).

3.7 Reflections on social representations theory for the study of risk

Hence, empirically, SRT is open to criticism on the clarity of its methods and perhaps as a consequence, some of its findings (Gaskell et al, 1990). Methods for describing social representations have presented recurring problems, as the ways in which the notion of representations may be conceptualised, articulated, and incorporated into empirical research are often ambiguous. Unfortunately, so far the framework offers relatively little guidance on the design of empirical research (Bauer et al, 1999). However, in the present study SRT is used in conjunction with the CMU approach with its very clear guidelines, ensuring mainly that risk representations can be captured in all their complexity and richness.

In essence, SRT is still a developing theory and further empirical research is required in order to resolve some of its empirical uncertainties. Overall, despite its limitations, it seems that SRT can make a vital contribution to the mental model approach to risk communication. By incorporating the social contexts of beliefs and focusing explicitly on common sensical knowledge, SRT may help better to understand how lay people make sense of a novel risk.

3.8 Conclusions Chapter Three

In conclusion, to study risk representations, the benefits of complementing the cognitively oriented CMU approach with the constructivist SRT approach are evident. Although the inclusion of lay views indicates that the CMU approach is a step in the right direction away from the information deficit model, it is still largely a top down approach aiming to bring lay views more in line with those of the experts. But risk communications require more than the simple information-deficit correction approach targeted at the individual. They also require acknowledgement of the motivational and subcultural dynamics that underpin the development of the original mental model (Breakwell, 2001).

Hence despite offering a useful framework to characterise the understanding and relevance of particular risks to people, the CMU approach can be criticised with regards to its individualistic orientation and neglect of the social origins of beliefs. While the approach can be used to make sense out of data and support the design of relevant communication content, it is questionable whether it is sufficient to address societal risks such as GM food.

To alleviate these shortcomings the present thesis synthesises the CMU approach with SRT to effectively mediate between social and individual structures. By looking at risk in its social and cultural contexts, we aim to “socialise” mental models.

Because it deals explicitly with common sense, SRT may provide risk communication research with a vital new perspective on lay knowledge. Rather than regarding lay risk perceptions as deviant, it is more fruitful to develop a deeper awareness of how people come to understand and reason about risk. This is the aim of the present study. The chosen research methodologies and procedures are outlined in the following chapter.

4 RESEARCH DESIGN AND METHODOLOGY

GM food has been a huge public controversy during the 1990s, receiving extensive media attention, and culminating in widespread public resistance. It is widely acknowledged that a major determinant of resistance to GM food, are lay risk perceptions which, as established in Chapter One, often differ significantly from those of scientific experts. And because expert and lay people perceive GM food risks rather differently, it makes communication between both parties challenging, partly because they do not “speak the same language”.

Thus it is increasingly appreciated that, in addition to the scientific estimates of a risk, lay concerns often dealing with moral and ethical risk dimensions may need to be addressed to avoid further public controversies. However so far, the power of the moral aspects of risk has been insufficiently researched. In many ways it is still insufficiently understood how expert and lay people make sense of risk. But in order to improve risk communication efforts, it first has to be better understood how risks are “constructed” by both groups.

4.1 Research aims and objectives: Part I

The aim of the first part of the present thesis is an exploration of expert and lay GM food risk representations with the help of the two frameworks outlined in the previous chapter, i.e. the science-based CMU approach and the constructivist social representations theory.

1. Part I explores expert and lay representations of GM food risk in depth using the CMU approach.
 - 1.1 Accordingly, the first objective is to create an expert mental model of GM food risk to show GM food risk based on science.
 - 1.2 The second objective is to create a lay mental model of GM food risk to show how lay people perceive the risk.

1.3 In line with the CMU approach, expert and lay mental models are compared and contrasted to show similarities and differences in both groups' representations of GM food risk.

1.4 In turn, this comparison is aimed to provide some implications for risk communication.

4.2 Research aims and objectives: Part II

The research proceeded incrementally. The first part of the research as outlined above was followed by a secondary study which aimed to answer some of the questions raised in the first part. The exploration of the CMU approach led us to focus on the non-scientific issues within the GM food debate and how, if at all, the CMU approach might deal with those.

2. Thus Part II explores lay perceptions of one particular non-scientific dimension of GM food risk, namely lay people's concern that GM is '*messing with nature*'.

2.1 The objective is to investigate what people actually mean when they make the judgement that GM is '*unnatural*' and is '*against nature*'.

2.2 Therefore, the frames and anchors people use to make the judgement that GM is '*unnatural*' are explored.

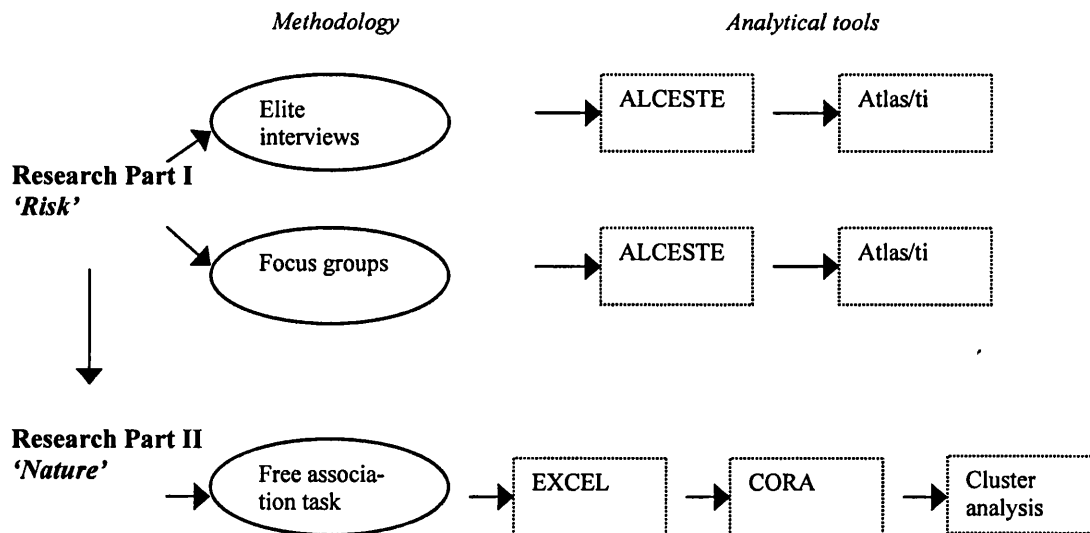
2.3 By viewing GM food in the context of other nature- and food-related 'objects' we aim to establish a comparative judgement to show how nature and naturalness are constructed in relation to food.

4.3 Research design

For our study of representations of GM food risk, we chose three types of qualitative methodologies: for the first part of the research interviews and focus groups, and for the second part, a free associations task. Figure 4.1 shows an outline of the research design. In line with the CMU approach the first research part comprises in-depth interviews of nine scientific experts on agricultural biotechnology about the risks and benefits associated with GM foods. Secondly, with a topic guide based on the results of the first step, five focus groups were conducted with the lay public. Data were triangulated with ALCESTE and Atlas/ti.

The second research part, focusing specifically on lay representations of nature and naturalness in relation to food, comprises an internet administered free associations task. Data were prepared with EXCEL for the further analyses with correspondence analysis (CORA) and cluster analysis. All analytical tools are explained in detail in the relevant chapters.

Figure 4.1 Research design



The following section discusses why we chose qualitative research to answer the research questions outlined above and introduces the chosen methodologies, before we present the research procedures for the first part of the study.

4.4 Investigating representations of risk

The original meaning of the word method is “*a route that leads to the goal*” (Kvale, 1996; p.12), thus one has to first determine what the goal of the research is. There is no single best way of doing social research as qualitative and quantitative methodologies have different contributions to make. For the present research aims, there are two major benefits of using qualitative methodologies. First, this approach can help to examine risk representations in their contexts, and second, it allows the participants, rather than the researcher, to set the agenda.

As outlined above, the overall aim of the present thesis is the exploration of expert and lay representations of GM food, examining in detail how and why these representations may differ. Thus we focus on concrete cases in their social, cultural and historical contexts. Qualitative research is more suitable to achieve these research goals because it aims to understand beliefs, attitudes, values and motivations in-depth and in relation to the behaviours of people in particular social contexts (Gaskell, 2000).

Further, an essential difference between qualitative and quantitative methods of research in the social sciences concerns the issue of who sets the agenda- the researcher or the respondent (Farr, 1993b). Since the present thesis is primarily concerned with studying risk as experienced by the audience, it is important that the researcher does not impose her own representations on those of their informants. When aiming to understand expert and lay risk representations qualitative methodologies are useful to provide access to respondents’ *cultural* and *moral* worlds (Silverman, 1993).

Moreover, as neither the form nor the content of a representation that will emerge from an investigation can be known in advance (Moscovici, 1987), there is a general

preference for the use of qualitative techniques to study both social representations (e.g. Gervais, 1997; Herzlich, 1973; Jodelet, 1983) as well as mental models (e.g. Bostrum et al, 1994; MacGregor, Slovic and Malmfors, 1999; Owen, Colbourne, Clayton and Fife-Schaw, 1999).

4.4.1 Interviews

Tarde (1910) first maintained that representations are created in the course of conversation. He demonstrated how they emerge in specific places, how they are determined by the physical and psychological dimensions of those encounters between individuals, and how they change over time. Conversation shapes and animates social representations and thus gives them a life of their own (Moscovici, 1984).

Consequently, interviews, often described as a conversation, albeit with a purpose (e.g. Glazier and Powell, 1992; Rubin and Rubin, 1995) are particularly useful to examine people's shared beliefs in a social context.

Hence as proposed by the CMU approach to risk communication for the first part of the thesis we utilise open-ended interviews. Here, expert and lay mental models are extracted from interview transcripts. The major advantage of this method is that open-ended responses can identify those concepts that respondents themselves perceive to be relevant to the domain in question (Rouse et al, 1986). Participants can be encouraged to explore their own knowledge structures as each topic raised by respondents, they can later be asked to elaborate (Granger Morgan et al, 2002). The limitation is of course that the approach is exceptionally time- and labour-intensive limiting studies to very small numbers.

4.4.2 Elite interviews

In accordance with the CMU approach to risk communication, we conduct in-depth elite interviews with scientific experts on agricultural biotechnology. Elite interviews are a specific form of, generally semi-structured, interviews whereby the range of potentially relevant information provided largely deals with a particular expertise (Moyser and Wagstaff, 1987). Unfortunately, while interviews are established as an

effective method of data collection for research on elite subjects (Odendhal and Shaw, 1995), there is still a shortage of methodological literature on applicable research practises. With few exceptions (e.g. Hertz and Imber, 1995; Moyser et al, 1987) the literature of interviewing seldom differentiates between elite and non-elite subjects, although there are some identifiable difficulties specifically in relation to the former. For example, problems of access often abound, and it may be especially difficult to get past gatekeepers.

Further, since the term elite is closely linked with the operation of power, control and privilege, any analysis of elites also depends on the broader interpretations of power in society, and on an understanding of the relationship between elites and non-elites, and their respective environments (Odendhal et al, 1995). Thus elites should not be studied in isolation from the contexts in which they operate, making it critical that researchers substantiate elite interviews with additional non-elite interviews (Odendhal et al, 1995). In line with this suggestion, the present thesis combines elite interviews with scientific experts with focus groups to study non-elite (in our case lay) participants.

4.4.3 Focus groups

Individual and group interviews are in many ways, very similar and can be equally effective for answering certain research questions (Morgan, 1998). Both methodologies constitute dynamic *meaning-making* occasions as knowledge is created through the points of view of the interviewer and the interviewee as both actively construct meaning in each other's talk (Silverman, 1997).

Yet it has been suggested that the focus group context has several advantages over the individual interview, such as that it facilitates openness and enhances disclosure (Wilkinson, 1998). Wilkinson argues that social desirability is less of a problem in focus groups than in interviews, as discussions tend to generate expressions of more 'socially undesirable' opinions. In a group, people are more willing to entertain novel ideas, to take greater risk and to show attitude polarisation (Gaskell, 2000). Thus group pressure can be viewed as positive rather than negative because it can stimulate new ideas and thought (Wilkinson, 1998).

Although in focus groups, the researcher has less control over the data produced than in one-to-one interviews (Gibbs, 1997) this may be advantageous rather than disadvantageous. Compared to the individual interview, it is harder still for the researcher to impose his own agenda in the group context. The researcher's influence is diffused due to being in a group rather than a one-to-one situation, enabling participants' to better explore their own meanings (Morgan, 1998).

4.4.4 Functional equivalence of interviews and focus groups

Like individual interviews, focus groups enable the researcher to listen to participants. But since focus group participants talk primarily to each other, they talk in a way that is much closer to everyday conversation than in the one-to-one interview. Focus groups share many of the features of ordinary social interaction, and reflect everyday social processes, such as sharing information, expressing dis/agreements, asking questions and providing answers (Wilkinson, 1998). Thus an advantage of the opinions generated in group, over opinions elicited from individual interviews, is that they have a higher degree of external validity (Wilkinson, 1998).

Essentially, focus groups might generate opinions more like those of the public than would even a large number of isolated respondents because they are influenced by the social nature of the group interaction, rather than relying on the individual perspective (Gaskell, 2000).

Consequently the social dynamics through which mental models are acquired and maintained can be highlighted. Because the interplay of the personal and the social can be explored, focus groups are especially functional for investigating the structure and processes of social representations (Breakwell, 1993). In that sense, the limitation that the mental model approach is strongly centred on the individual, ignoring the wider social environment can, to an extent, be overcome by utilising focus groups rather than individual interviews.

In contrast, focus groups are less appropriate for experts. Apart from the pragmatic difficulties of convening high ranking scientific experts in one session, it may also inhibit discussion, and lead to arguments. Therefore, conducting elite focus groups

would have been less suitable for examining different expert perspectives. Thus for the present study, lay focus groups and expert interviews can be seen as functionally equivalent.

4.5 Free associations

For the second research part, the present study utilises word association tasks to examine issues that were found to be important distinguishing factors between expert and lay people (i.e. issues concerned with nature and naturalness in relation to food), in depth and on a larger sample.

In essence, free associations are a special form of open questions, which can give good access to the understanding respondents have of a target object (Wagner, 1997). People are simply asked to spontaneously say what comes to their mind in relation to a particular stimulus, such as a word or a picture.

Free associations bear resemblance to the idea of associative memory in cognitive psychology. An associative memory is a system which stores mappings of specific input representations to specific output representations. That is to say, a system that “associates” two patterns such that when one is encountered subsequently, the other can be reliably recalled (Kohonen, 1984). In that way, we can infer that respondents’ associated words to say ‘*natural things*’ to some extent parallel their representations of the object in their memory.

In social psychology, free associations were initially used as a means to investigate shared conceptions of widely used notions (such as intelligence) assuming that results show a consensual appreciation of reality, allowing access into people’s knowledge structures (Doise, Clements and Lorenzi-Cioldi, 1993). Moreover, free association tasks have frequently been used for the study of social representations (e.g. Di Giacomo, 1980; de Rosa, 1988). The resulting free associations data has the benefit that it can be relatively easy formalised and utilised in a wide range of ways.

According to Wagner (1997), the word association technique can be located somewhere in-between closed questions and qualitative techniques. On the one hand, they

can be applied to larger samples in a reasonable short amount of time. On the other hand, they allow rather unrestricted access to what respondents think. Unfortunately, to date the method is still an under-theorised technique.

4.6 Refuting criticisms of qualitative research

From a positivist perspective, qualitative approaches are often criticised on several points, such as the lack of generalisability of their findings. But in qualitative approaches the goal of generalisability is replaced by an emphasis on contextuality and heterogeneity of knowledge.

The particular strength of many qualitative approaches is their advantaged access to the common sense understanding of participants which provides their worldview (Kvale, 1996). Thus for the present research, the deliberate use of the subjective perspective is not a negative bias. Rather than lacking objectivity, the qualitative interview may obtain a privileged position of the social world because it allows the researcher to explore representations within a linguistically constituted and interpersonally negotiated social world (Kvale, 1996).

Additionally, a major criticism of qualitative research is concerned with their assessment methods. In the positivist tradition, representativeness, reliability, and validity are the criteria of sound research. But these criteria are less applicable for qualitative research as they do not adequately acknowledge the specific character, aims and objectives of qualitative inquiry (Gaskell and Bauer, 2000).

Regarding representativeness, in qualitative research it generally does not make sense to ask and answer questions of sampling or specific methods in an isolated way. Whether sampling is appropriate can only be answered with reference to the research question, to the results, to the generalisations that are aimed at and to the methods used (Flick, 1998). As the aim of the present research is not to establish the population prevalence of certain beliefs, but rather to explore specific representations of risk, the relevance of the cases is more important than their representativeness.

Concerning reliability and validity, Gaskell and Bauer (2000) note a dilemma between these criteria in qualitative research. High reliability does not automatically confer validity, as in interpretation validity may be associated with low reliability. And while inter-coder reliability may provide a partial solution, it can be questioned whether different coders have a valid interpretation of the text (Gaskell et al, 2000). Thus the present study adopts a range of alternative assessment criteria in accordance with Gaskell et al¹⁴.

4.6.1 Alternative assessment criteria for qualitative research

Gaskell et al (2000) recommend claims-making and public accountability as the central issues in the qualitative research process. Claims-making suggests that claims based on empirical research must be supported by rigorous evidence, while public accountability describes the idea that science operates in public, rather than private, domain. The latter rests on claims within two broad criteria: confidence and relevance.

Confidence markers for qualitative research incorporate triangulation and reflexivity. Therefore, we triangulate the methodologies in both parts of the research to validate findings. Further, transparency and procedural clarity are provided through the detailed descriptions of the research procedures (as well as the appendices). Moreover, the use of thick description shows how e.g. codes and quotations occur in their original contexts.

Another confidence marker is corpus construction which, Gaskell et al argue, is functionally equivalent to representative sampling and sample size as it aims to maximise the variety of unknown representations. This we aim to achieve with our range of expert participants and the segmentation of the focus groups. Since sample size is less important than evidence of meaning saturation few interviews distributed across a wide range of strata are preferable over the absolute number of interviews (Gaskell et al, 2000).

¹⁴ Various other efforts have been made to develop new standards and rules for assessing qualitative research. Generally, these incorporate similar criteria such as trustworthiness, credibility, dependability, transferability and confirmability (e.g. Lincoln and Guba, 1985).

Additional relevance markers (referring to the extent to which the research is viable in the sense that it links to theory internally or some common sense externally) include local surprise and communicative validation (Gaskell et al, 2000). Hence to gain further data authenticity, participants were offered the opportunity to read the interview transcripts and/or view findings on a webpage and provide feedback if they so wished.

These alternative criteria imply that qualitative research should be assessed through its own particular principles, rather than traditional positivist benchmarks, in order to fully capitalise on the values of this research perspective. Applying alternative assessment criteria, qualitative methodologies clearly offer a valid and sound strategy for conducting social research.

Akin to choosing a research perspective, deciding on a particular methodology always brings with it its own benefits and limitations. The decisive factor is that the method used is consistent with the assumptions and underlying principles of the theory. With regards to the present research topic and the research objectives, we have shown three different qualitative methodologies- elite interviews, focus groups and free associations- to be suitable to study representations of GM food. The following section outlines our research procedures for the first part of the thesis.

4.7 Research procedure: Part I

4.7.1 Elite interview participants

Expert participants were chosen from a broad range of UK institutions dealing with plant biotechnology. These included the Advisory Committee for Novel Food and Processes (ACNFP), the Advisory Committee for Releases to the Environment (ACRE), the Agriculture and Environment Biotechnology Commission (AEBC), the Institute for Food, Science and Technology (IFST), the John Innes Centre, the Agricultural Technologies Group English Nature, the British Society of Plant Breeders, and Genewatch UK.

These institutions advise the UK government on decisions related to agricultural biotechnology, and are recognised as providing the highest level of scientific expertise. The selection of expert interviewees was based on their positions within these institutions. Using a 'top-down approach' those deemed to possess exemplary reputations (such as 'chair' or 'director') were contacted first, and if unavailable, asked to refer an alternative participant.

Participants were initially either contacted via email (directly, through referral or via gatekeepers), or approached at open gatherings related to the GM Science Review (2003), and asked to participate in an interview about GM food. During these initial contacts, the researcher's identity was presented and the research aim was clearly stated. In that way, Morse's (1994) criteria of a "good informant"¹⁵ were met. Nine expert participants were successfully recruited.

4.7.2 Elite interview topic guide

In accordance with the CMU approach, the expert topic guide was driven by the scientific and popular literature on agricultural biotechnology. Issues to be addressed included current and future developments in relation to GM food, issues of food safety and regulation, and various issues of scientific uncertainty. Interviews were semi-structured to allow for unexpected information, and the interview schedule was kept flexible, although the topic guide was followed fairly consistently to increase the comparability of data.

Questions were open-ended to invite opinions and general knowledge, and to cover areas where the interviewer's own knowledge was lacking. In order to critically examine alternative perspectives several confrontational questions were included. Please see Appendix A for the expert topic guide.

¹⁵ In relation to expert interviews, Morse (1994) defines a 'good informant' as someone who firstly, has the necessary knowledge and expertise of the issue under study, secondly has the capability to reflect and articulate, and thirdly is willing to participate.

4.7.3 Elite interview procedure

Interviews were conducted between February and May 2003. Location and timing of the interviews was chosen at the interviewees' convenience. For this reason, some interviews were conducted via telephone. An explanation for the interview was given, and the significance of the research and the individual's participation in it was emphasised. Confidentiality was assured. The possibility of withdrawing from the interview at any time should the participant wish to do so was offered, and any further questions were answered. Interviews lasted between 30-90 minutes after which interviewees were thanked for their participation.

All interviews were tape-recorded with participants' consent and transcribed verbatim applying the general CAQDAS transcription guidelines (Lewins, 2002).

4.7.4 Elite interview pilot study

Problems during elite interviews can include blockage of the interview as the interviewee proves not to be an expert as previously assumed (Moyser et al, 1987). This was the case with our first pilot interview, which accordingly was excluded from further study. Although the requirement of expert knowledge in the field of GM food was stated explicitly during the initial contact, the pilot study indicated the need, to ask participants directly whether they considered themselves to be an expert in this area.

Also, as several issues were shown to be ambiguous the topic guide was amended accordingly. Definitions of 'GM food' were unclear, and needed to be refined. GM food can be defined as either food, which was processed using a GM ingredient, but does not contain any traceable genetically modified DNA (such as Canola oil), or as an actual GM product, such as a genetically modified tomato. Experts (as well as the literature) are equivocal on the issue of how to define a GM food. Therefore, the present research utilises the broader definition, characterising both process and product as GM food.

Furthermore, question wording was amended in that the question ‘what are the risks’ was changed to the more constructivist ‘what do we know about the risks’. Results of the pilot study are not included in the final analysis.

4.7.5 Focus group participants

We utilised a segmented convenience sample to explore a wide range of representations of GM food. Respondents were initially contacted via email and invited to participate in a focus group. The focus group was presented as ‘*an organised but informal discussion*’ about the risks and benefits of GM food, to ensure that participants would have something to say about the topic. Taking advantage of social networks, snowball sampling was utilised.

Focus groups commenced between May and June 2003. The invitation to the focus group was sent out 2-3 weeks in advance, and feedback was received from 45 respondents who were willing to participate. A remainder was sent out two days in advance. Recruitment resulted in 39 participants with a mean age of 32 years (SD 8.3), with a male/female ratio of 40/60. This ensued in five focus groups of between 6-10 individuals. All participants were UK residents. As a consequence of the social networking, in each focus group participants shared some common characteristics as shown in table 4.1, creating a comfortable environment for a productive discussion about the topic.

Table 4.1 *Segmentation of focus groups*

• Focus group 1 ‘ <i>country</i> ’: Participants living in the countryside/villages
• Focus group 2 ‘ <i>law</i> ’: Lawyers
• Focus group 3 ‘ <i>mature</i> ’: Mature participants with children
• Focus group 4 ‘ <i>finance</i> ’: Finance students
• Focus group 5 ‘ <i>PhD</i> ’: Social Psychology PhD students

The relatively small number of both interviews and focus groups was sufficient as the point of meaning saturation, where no novel concepts appeared, was reached.

4.7.6 Focus group topic guide

The focus group topic guide was informed by results of the expert interviews. It addressed issues of risk, benefit and risk management in relation to GM food. Focus groups were moderately structured to be open to participants' ideas while still addressing the researcher's interests. Thus a funnel design was used as suggested by Granger Morgan et al (2002). Two broad, open-ended questions (*'what comes to your mind when I mention the word GM food'*, *'what is your opinion on GM food'*) let participants express their own thoughts on the topic. This was followed by several central and more specific topics dealing with public health and environmental risks and benefits. For an outline of the focus group topic guide, please see Appendix B.

4.7.7 Focus group procedure

Focus groups were conducted at the London School of Economics and at participants' homes, making participation as convenient as possible. Refreshments were provided. In each group, participants were introduced to the moderator (myself) and the research topic. Confidentiality was assured and participants were reminded that they could leave the group at any time should they wish to do so. Participants were informed that they should not worry about right or wrong answers as the study was specifically interested in what they had to say about the topic. When questions were addressed to the moderator, participants were told that any questions would be answered after the discussion. Focus groups lasted between 1-2 hours, after which participants were asked to complete a brief document detailing their demographics. All participants were thanked for their participation.

Focus groups were tape-recorded with participants' consent with two recorders to provide backup for the data, and then transcribed verbatim applying the general CAQDAS transcription guidelines (Lewins, 2002).

4.7.8 Focus group pilot study

A pilot group was conducted with six participants. Changes to the topic guide were not required, thus results were incorporated in the final analysis. However, the pilot

group was relatively small, hence subsequent group were over-recruited by two participants.

4.7.9 Ethical considerations

For both elite interviews and focus groups, ethical guidelines as proposed by the British Psychological Society (1999) were followed. The present study did not require any further ethical considerations beyond confidentiality and obtaining informed consent. When selecting and involving participants full information about the purposes and uses of participants' contributions was provided.

5 EXPLORING EXPERT AND LAY REPRESENTATIONS OF GM FOOD

The first exploratory data analysis of the elite interviews and focus groups was conducted with the analytical tool ALCESTE. We provide a brief theoretical background to ALCESTE before describing our analytical procedure. Moving on to the results, the basic results are presented first, before the lexical classes and the resulting correspondence spaces are examined. Expert and lay findings are presented separately before a comparison is drawn.

Both interviews and focus groups analyses resulted in four clusters. As could be expected in relation to the topic guides, both groups address similar issues albeit from different perspectives. For instance, the cluster '*environment*' shows that experts discuss the environmental risks of GM largely from a physical and agricultural perspective. In contrast, rather than focusing on the environmental impacts of GM *per se*, lay people frame the discussion in terms of a broader '*nature*' debate indicating the incorporation of a different type of underlying values.

The results show that ALCESTE can offer a valuable initial analysis helping to make sense of a relatively large data set very quickly. However, findings also indicate the need to investigate the data in more depth, which is done through the Atlas/ti analyses in Chapter Six.

5.1 A theoretical background to ALCESTE

ALCESTE is a computerised technique for text analysis developed by Reinert during the 1980s. It is a tool for determining the main word distribution patterns within a text and it aims to obtain a primary statistical classification to reveal the most characteristic words and patterns. In the words of Reinert (1998; p.1):

“The objective is to obtain a primary statistical classification of the ‘simple statements’ of the studied corpus in function of the way words are distributed within these ‘statements’- in order to reveal the most characteristic words.”

Based on correspondence analysis¹⁶, ALCESTE categorises the text into clusters according to the distribution of vocabulary found. The analysis substitutes sentence meaning by examining local co-occurrences of words. The underlying idea is that the meaning of sentences can be captured if one finds those words that occur together in sentences and that are produced by as many respondents as possible (Kronberger and Wagner, 2000). This allows for conclusions such as that a substantial number of lay participants associate GM food with health risks.

Hence ALCESTE can help to understand collectively shared points of view as its underlying assumption is that different point of reference produce different ways of talking, i.e. the use of a specific vocabulary is seen as a source for detecting ways of thinking about an object. The ALCESTE analysis aims to distinguish word classes that represent different forms of discourse about a topic of interest (Kronberger et al, 2000).

After preparing the text, the analysis can be run using standard parameter settings so that the subsequent output is not influenced by the researcher's preconceptions. Since categorisation often introduces researcher's bias and needs to be well justified (Kronberger et al, 2000), the present research preferred to first 'let the data speak'. As text is coded automatically, ALCESTE was ideal for this purpose.

In order to successfully analyse a text corpus, two preconditions have to be met. The corpus has to be relatively homogeneous (i.e. focus on one topic), and exceed 10,000 words in length. In the present study, both conditions were met.

The main advantage of ALCESTE is that large quantities of material can be analysed quickly for recurring themes or topics. While it is less suited to hypothesis testing, it is appropriate for a preliminary exploration and description of data. Moreover, the ALCESTE findings provided a valuable basis for the subsequent Atlas/ti coding frame.

¹⁶ Correspondence analysis is discussed in more detail in relation to the second research stage. But for a detailed review of this technique, please see Greenacre and Blasius (1994).

5.1.1 Analytic procedure: ALCESTE

1. Transcripts of expert interviews and lay focus groups were analysed as two separate data sets.
2. Data sets were saved as ASCII files with line breaks and the texts were prepared in the following way.
3. Capital letters at the beginning of a word are automatically changed to lower case by ALCESTE. The interviewer's/moderator's questions were changed to upper case letters, so as not to be included in the main analysis. Upper case words in the document to be included in the analysis were changed into lower case letters, e.g. 'GM' was changed into 'gm' by using the search and replace function.
4. As the symbols '*' and '\$' are used as special tags by ALCESTE, they were removed from the main text.
5. All apostrophes were replaced by underscores (_) in order to be recognised as single words (e.g. 'it's' was changed to 'it_s').
6. ALCESTE uses a hierarchy of context units on which the analysis is based. Units can be defined by the user by tagging the text accordingly, and additional passive variables (e.g. age) can be included. An Initial Context Unit (ICU) represents a pre-existing division of the text and has to be specified. An Elementary Context Unit (ECU) is a unit of text within which ALCESTE calculates the frequency of word co-occurrences. In the present analysis, each of the nine elite interviews comprised a separate ICU. To be able to identify each expert 'passive' variables were used to tag each participant, such as **** *Expert_1.
7. Similarly, each focus group presented a separate ICU, with units tagged with each group's identification, such as **** *Fg1 *country.
8. ALCESTE uses a technique called 'lemmatisation' whereby words are reduced to their root form to reflect their semantic similarity. For example, the words 'regulation', 'regulate' and 'regulatory' were all reduced to 'regulat'. The dictionary of significant words in the output was examined and forms which were not recognised by ALCESTE (but with likely significance for the findings), were replaced manually, e.g. all occurrences of 'lied' were replaced by 'lie'.
9. Further, all co-occurrences of 'genetically modified' were abbreviated to 'gm' for ease of presentation in the resulting correspondence analysis graphs. Also, for the purpose of the present analysis, it was decided to regard various GM foods as single words, such as 'gm_soya' and 'gm_ingredient'.

10. Lastly, responses were homogenised with respect to synonyms, with the most frequent synonym replacing the less frequent one. For instance, 'sweetcorn' was replaced by 'maize'.

The analysis was run. As a first step, ALCESTE automatically subdivides words into groups of function words (e.g. articles) and content words (e.g. nouns) which carry the sense of discourse and on which the final analysis is based (Allum, 1998).

As a second step, ALCESTE identifies word classes based on the concept of hierarchical classification analysis. For each class, ALCESTE computes a list of words characteristic of that class. The strength of association between each word is expressed by a chi-square value. Thus the chi-squared criterion here is used as a measure of relationship existing between words rather than as a test. All words exceeding a certain chi-square value are listed. The larger the chi-square value the more important the particular word is for the construction of the class. Word lists can then be utilised to interpret the classes.

Third, the 'Clé sélectionnée' comprises a set of original and prototypical 'key' statements associated with a class, showing the context within each word is used in the original text.

Finally, ALCESTE presents results in a correspondence space, where relationships between classes are represented. Graphs produced can be super-imposed and read in conjunction. Ideally, the interpretation then should give some semantic content to the purely structural information produced by ALCESTE (Kronberger et al, 2000).

To ensure stable results, ALCESTE computes two sets of classifications utilising different lengths of text units. An acceptable solution classifies at least 70% of text units (Kronberger et al, 2000).

5.2 ALCESTE analyses: Basic information

Table 5.1 provides a summary of the basic statistics relating to the corpora of the elite interviews and focus groups. The total word count is slightly higher for the focus groups than for the interviews, but both corpora satisfy the minimum recommended word count. The unique words analysed reflect the range of vocabulary employed in each setting. The vocabulary used in the elite interviews is more versatile than in the focus groups, possibly due to the often subject-specific terminology used by experts.

The passive variable counts show the number of tagged indicators in each corpus. The nine variables in the elite interviews represent the nine interviews conducted; in the focus group, each variable represents one focus group. Likewise, each interview and focus group was tagged as a separate ICU.

Table 5.1 *ALCESTE analyses: Basic information*

	<i>Elite interviews</i>	<i>Focus groups</i>
Total word count	32630	36841
Unique words analysed	2323	1710
Passive variables	9	5
ICUs	9	5
Classified ECUs	592	645
Text units classified (%)	78.51	76.15
Lexical classes	4	4
Distribution of classes (%)	A 18.92 B 11.66 C 41.72 D 27.70	A 16.12 B 9.62 C 32.09 D 42.17

Additionally, table 5.1 presents the number of classified ECUs along with the classified text units to give an indication of the stability of results. Classified units in both corpora exceed the 70% acceptability mark proposed by Kronberger et al (2000). Thus based on the internal criteria defined by ALCESTE, the classes identified are reliable representations of the text.

As table 5.1 shows, ALCESTE identified four classes for both interviews and focus groups, albeit of varying distributions. For the purpose of clarity, lexical classes are described separately for each corpus, before a comparison is drawn.

5.3 Lexical classes: Elite interviews

Table 5.2 shows the thirty most characteristic words from each lexical class in order of descending significance.

Table 5.2 *Elite interviews: Characteristic words ordered by strength of chi² association**

(A) Regulation	(B) Risk	(C) PUS	(D) Environment
Food+ (55)	Gene+ (36)	Know (79)	Crop+ (87)
Product+ (39)	Risk+ (27)	People+ (62)	Farm+ (45)
Label+ (35)	Into (26)	Think (76)	Grow (40)
Consumer+ (30)	Put (18)	Well (61)	Use+ (30)
Process+ (24)	Plant+ (16)	Problem+ (46)	Organic (30)
Gm (23)	Assess+ (12)	Allerg+ (32)	Benefit+ (28)
Gm_food+ (21)	DNA (11)	Public+ (28)	Produce+ (22)
Oil+ (14)	Take (11)	Science+ (25)	Field+ (23)
Cheaper+ (16)	Experiment+ (10)	Scientist+ (19)	Herbicide+ (21)
Europe (12)	Hazard+ (9)	Understand (18)	Land+ (20)
Contain+ (11)	Rice (9)	Try (18)	Resist+ (19)
Allow+ (10)	Find (8)	Sure (16)	Technolog+ (16)
Point+ (10)	Potential+ (8)	Important+ (16)	Bt (16)
Breed (10)	Expert+ (8)	Commercial+ (16)	Agriculture+ (16)
Possibilit+ (9)	Introduce+ (8)	Part+ (15)	Trait+ (14)
Choice (7)	Question+ (7)	Improve+ (13)	Reduce+ (12)
Accept+ (7)	Technique+ (7)	Big (13)	Seed+ (12)
Sell (7)	Protein (7)	Social (12)	Pest+ (11)
Supermarket+ (6)	Lecithin+ (6)	Regulation+ (11)	Movement+ (11)
Retailer+ (6)	Wild (6)	Address+ (11)	Weed+ (12)
Detect+ (6)	Place+ (6)	Solve+ (10)	Pesticide+ (11)
Derive+ (6)	Identify (5)	Tend+ (8)	Environment+ (11)
Gm_product+ (5)	Ecolog+ (5)	Diet+ (8)	Rape (11)
Simple (5)	Toxic+ (5)	Role+ (8)	Tolera+ (10)
BSE (5)	Cut (4)	Concern+ (8)	Serious+ (10)
Control (5)	Affect+ (3)	Extreme+ (8)	Application+ (10)
Relative (5)	Unlikely (3)	Micro (8)	Industr+ (10)
Gm_ingredients (4)	Insert+ (3)	Favour+ (7)	Hybrid+ (9)
Derivatives (4)	Manage+ (3)	Food_production+ (7)	Drought+ (9)
Nature (4)	Aware (3)	Long_term (6)	Available (9)

*Distribution of the original forms per root in brackets.

+ = word stem

The most characteristic words of class A are 'food', 'product', 'label' and 'consumer'. Indeed this class largely focuses on issues related to labelling, definitions of GM food, and scientific regulatory issues, often connected to European rules.

The most characteristic word of class B is 'gene'. The smallest of the four classes it centres particularly on the science of genetic modification, the potential of the technology and scientific risk assessment *per se*.

While still addressing the scientific developments in relation to GM food and the potential nutritional benefits, the largest class (C) especially deals with the intricate relationship between scientists and the public. This is shown in the most characteristic

words, such as 'know', 'people', 'public' and 'scientist'. The word 'regulation' may be part of this class because experts frequently discuss the lack of public knowledge about and/or trust in the management of GM. The fact that class C is the largest class, even though experts were not specifically asked about public perceptions, indicates that experts do not necessarily view scientific and lay perceptions of GM as distinct:

"You did not want to ask me about public perceptions but the ways the public perceive the risks are also very important. And if the public thinks there are risks then the scientists have to listen to them. So it's not quite as distinct as you suggest because over the last few years we've learnt to listen to the public very hard."

(Expert 1)

Different to the other three classes, class D specifically addresses current GM developments in relation to their effects on the environment and on agriculture, such as the development of herbicide-resistant crops. Noticeably, the word 'benefit' is strongly associated with this class. Like class B, this class addresses the predominantly scientific side of GM technology. Consequently, the terminology used is of a more technical nature than in classes A and C.

5.3.1 Relationships between words and classes

For each class, ALCESTE also classifies the most characteristic word groupings to understand the links between the words in each class, as shown in table 5.3. These word groupings can be taken as indicators of the context.

Table 5.3 *Elite interviews: Most characteristic word groupings per class*

Class	Word grouping	
(A) Regulation	Breed Conventional Current+ substantial_equivalence	Control+ relative+ Process+ product+
(B) Risk	Identify hazard+ Assess+ risk+	Introduce+ rice Experiment+ lecithin+
(C) PUS	Vitamin_A+ micro_nutrient+ Play+ role	Enhance+ vitamin+ Social science+
(D) Environment	Crop+ rape Hybrid+ seed+	Organic movement+ Benefit+ pesticide

For instance, the most characteristic word groupings in class B are 'identify hazard(s)' and 'assess risk(s)'.

The relationships between words and classes are 'mapped' in figure 5.1. Whilst the classes 'environment' and 'regulation' present separate clusters, the clusters of the classes 'risk' and 'PUS' are overlapping, indicating that expert discourse often centres on both topics together.

Figure 5.1 Elite interviews: Correspondence analysis of characteristic words

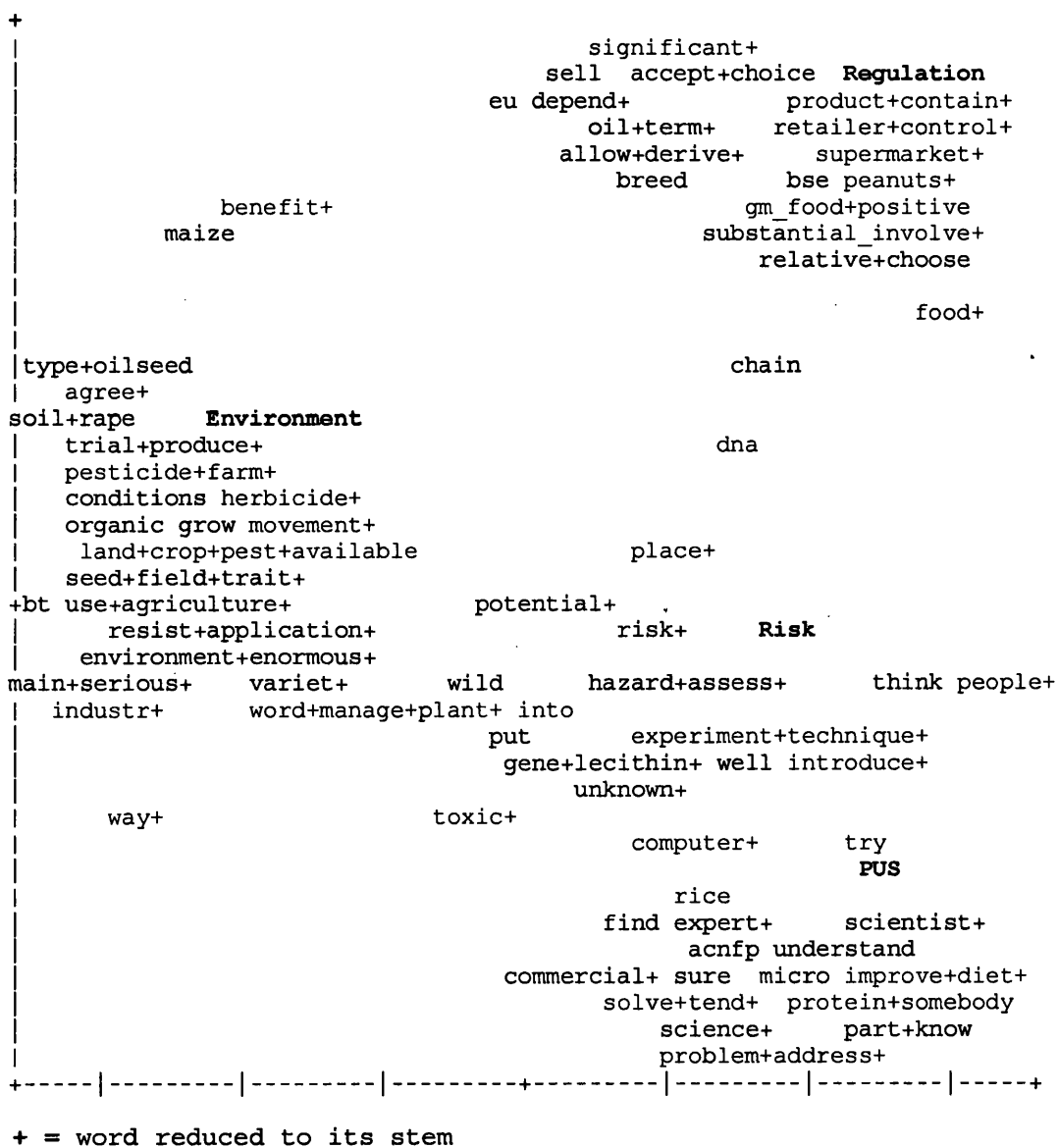
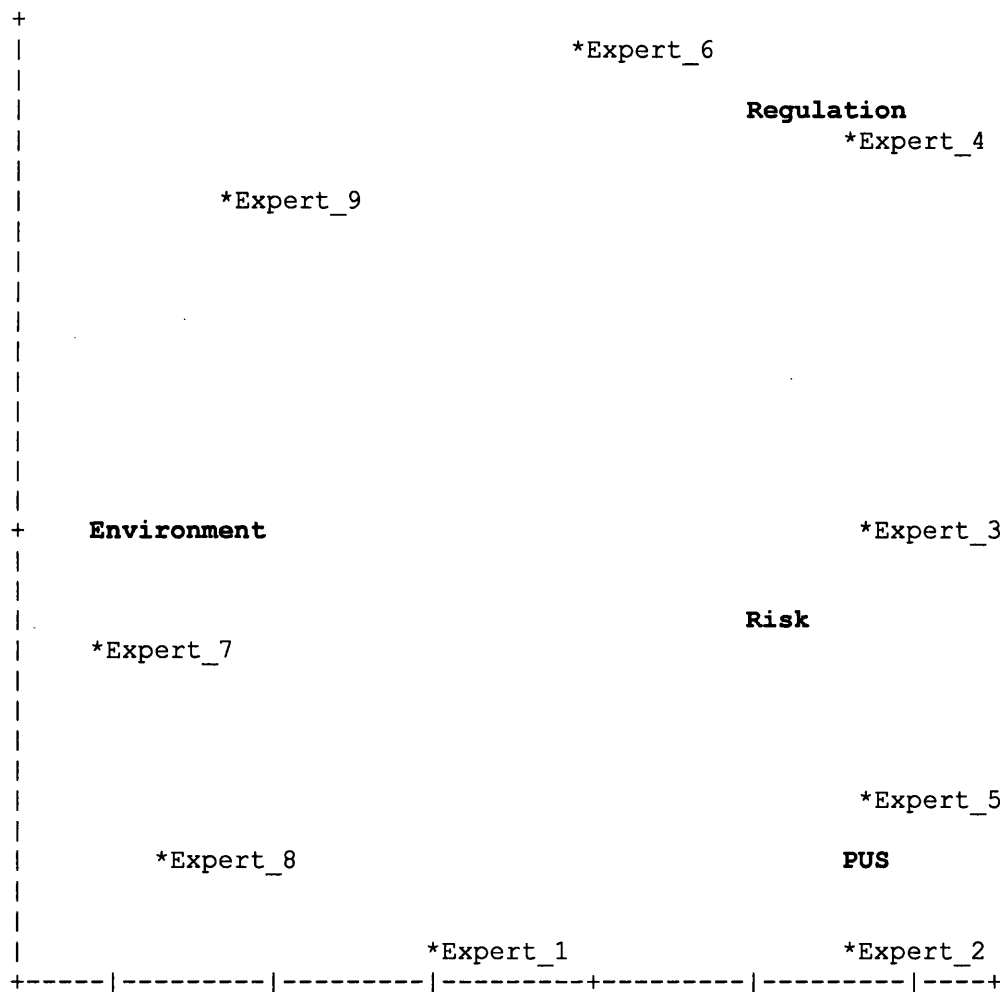


Figure 5.1 can then be superimposed by figure 5.2 to indicate which experts are associated with which class. For example, as could be expected, Expert 7 (professionally especially concerned with the environmental impacts of GMOs) is associated with class D (environment), while Expert 4 (an expert in food policy) is associated with class A (regulation).

Figure 5.2 Elite interviews: *Correspondence analysis of experts and lexical classes*



To further contextualise the above findings, table 5.4 shows the most representative ECUs per class in descending order. The number in front of each ECU represents the χ^2 value of association with the particular class. For the purpose of brevity, only the three most significant ECUs are chosen. A full outline of representative ECUs results can be found in Appendix C.

Table 5.4 *Elite interviews: Most characteristic ECUs in each class*

<i>Class</i>	<i>Most representative ECUs per class</i>
(A) Regulation	<ul style="list-style-type: none"> • 56 what processes have been involved in the production of foods not simply what are the final ingredients. the label is not compulsory, it_s voluntary in most cases. Where they derive from maize and soya, currently in europe you do have to label. but you only label when there is detectable dna from the gm origins. (Expert 4) • 42 you can think of gm_products or products derived using gm_technology that would be advantageous in terms of lower processing costs, and subject to the economics of the food chain that might be passed on to the consumer in significant measure. (Expert 6) • 35 but there have been gm_foods on the market, including gm_ingredients, therefore gm_foods, and there are at the moment. Anything that contains maize and soya derivatives and flour or oils which is used extensively in food processing. (Expert 4)
(B) Risk	<ul style="list-style-type: none"> • 70 and that_s somewhere else in the body but there is no evidence at all that they are put into the gene material. If they were, you know you and I after eating potatoes for 400 years, might expect to find potato genes in our guts. (Expert 1) • 35 now the question then becomes, is there, because of the potential to put in a gene from a different species into a crop, does that create any special hazard? (Expert 6) • 34 you_ve inserted one gene in a particular place. or maybe two, but one is the typical thing. Actually, with the golden_rice it_s three or four, but never mind. you_re splitting specific genes and putting them into specific places in the dna. so you_re targeting very precisely. (Expert 2)
(C) PUS	<ul style="list-style-type: none"> • 21 that is rice enriched with pro vitamin_A, which would play a tremendous part in preventing blindness in children in southeast_asia. but there is work going on, and this is with micro nutrients. A lot of the problems with world hunger. It_s not just quantity, it_s quality and particularly the lack of micro nutrients like vitamins. (Expert 1) • 21 now they were beaten. Perhaps because they did not have the internet in those days, I do not know. but I think that has played a very big part. (Expert 2) • 19 the 8th of april is tuesday. so you see, we made a mistake. mistakes can happen. I know acnfp pretty well, I know some of the people who are on it, and I think they do a thorough and effective job. (Expert 2)
(D) Environment	<ul style="list-style-type: none"> • 49 it_s there all the time, but it_s not economically a serious pest in most cases there are only small patches of it. but herbicide tolerance is the main transformation that is available, and that_s the type of crop being grown in the usa very widely. (Expert 7) • 31 now that_s another way of doing it. and then there is research going on on gm_foods that can grow in conditions that have been inhospitable to those crops. crops that can grow on salty soils, making a whole lot of land available without encroaching on the wild environment. crops that will grow on aluminium rich soils, again making a lot of arable land available that previously was not arable land. (Expert 2) • 30 those crops are widely grown in the usa and there is a small amount of bt maize that_s grown in spain at the moment on a commercial basis, but it_s only a very small amount. (Expert 7)

5.4 Lexical classes: Focus groups

Table 5.5 shows the thirty most characteristic words from each lexical class in the focus groups ordered by strength of association.

Table 5.5 Focus groups: Characteristic words ordered by strength of χ^2 association*

(A) Industry	(B) Food	(C) Nature	(D) Science and politics
People+ (39)	Buy (36)	Gm (115)	Know (158)
Want+ (37)	Food+ (36)	Gene+ (64)	Real+ (81)
Make (33)	Gm_food+ (17)	Different+ (40)	Inform+ (52)
Help+ (32)	Label+ (17)	Nature (34)	Government+ (51)
Poor+ (29)	Organic+ (15)	Natural+ (28)	Trust+ (48)
Money (26)	Choice+ (14)	Change+ (28)	Risk+ (46)
Compan+ (26)	Supermarket+ (13)	Into (26)	Research+ (39)
Feed+ (19)	Look+ (8)	Plant+ (25)	Scientist+ (35)
World+ (19)	General+ (7)	Same (24)	Out (33)
Benefit+ (14)	Pay (7)	Animal+ (22)	Tell (31)
Countr+ (13)	Cheap+ (7)	Example+ (21)	Science (30)
Live+ (12)	Read (7)	Species (20)	Find (24)
Produc+ (12)	Expensive (5)	Put (19)	Decide+ (20)
Profit+ (11)	Probably (5)	Danger+ (19)	Interest+ (23)
USA+ (9)	Tesco+ (5)	Chemical + (19)	Public+ (21)
Everyone (9)	Additives (4)	Use+ (17)	Keep (21)
Third_world (8)	Ingredients (4)	Tomato (16)	Fact+ (19)
Give+ (8)	Prefer (4)	Unnatural+ (15)	Decision+ (18)
Sell+ (8)	Definitely (4)	Grow (15)	Bad (18)
Bring (8)	Cost (4)	Cancer+ (15)	Safe+ (17)
Pay (7)	Produce+ (4)	Worse (15)	Politic + (16)
Consumer+ (7)	Option+ (3)	Farm+ (15)	Question+ (13)
Nonsense+ (6)	Guess+ (3)	Breed (14)	Quiet (12)
Spend+ (6)	Processe+ (3)	Mess+ (13)	Harmful (11)
Distribut+ (6)	Somebody (3)	Pesticide+ (13)	Regulat+ (14)
Population+ (6)	Afford (3)	Cow+ (12)	Someone (12)
Resources (6)	Price+ (3)	Radiat+ (12)	Independent (11)
Market+ (6)	Contain (3)	Mix+ (12)	Industr+ (11)
Solution+ (5)	Stupid+ (2)	Kill+ (11)	Test+ (10)
Short_term (5)	Assume (2)	Hormones (10)	Progress+ (8)

*Distribution of the original forms per root in brackets

+ = word stem

Class A refers to conversation around corporate and commercial issues. Strongly associated words with this class are 'help', 'poor', 'money' and 'world'. This may be due to conversation often focusing on arguments initially brought forward by biotech companies such as 'GM will help to feed the third world', which are strongly rejected by lay participants as the contextualisation of words in table 5.6 indicates.

Class B is by far the smallest class and focuses on food and consumer issues, such as labelling, as well as consumer choice and food selection issues, such as the differences between organically grown and GM food.

Class C is associated with nature in a broad sense. Significant words include 'gene', 'nature' and 'natural', 'animal', and 'species'. While on the one hand, conversation focus on naturalness versus unnaturalness in general, on the other hand, this class is often food-specific with discussions moving from GM to radiation in food, and the use of hormones, pesticides and chemicals in food production. These various food production issues are often not clearly distinguished:

"I think it's scary, I have a bleak view of all those things. I like natural things and that technology is surely not natural. They just mix genes and chemicals and nobody knows what will happen. You put things into your body and they mix with your genes. I think they shouldn't put chemicals into our food and certainly not genes! I don't agree with that at all, all these chemicals cause cancer and it has been shown that allergies are increasing all the time here in the UK. GM would make that even worse."

(Female participant, 29, Fg 1 'country')

The largest class (D) focuses on communication between experts and the public, as well as the relationship between scientists and politicians. This is indicated by the words which are strongly associated with this class such as 'trust', 'government', 'know(ledge)' and 'inform(ation)'.

5.4.1 Relationships between words and classes

Table 5.6 presents the most characteristic word groupings of each class and gives an indication of the context in which the words are used. For example, frequently grouped together are 'long-term' and 'solution' (Class A), 'organic' and 'expensive' (Class B), 'mess(ing)' and 'nature' (Class C), and 'keep' and 'quiet' (Class D).

Table 5.6 Focus groups: Most characteristic word groupings per class

Class	Word grouping
(A) Industry	Long_term solution+ Nonsense+ feed USA+ product+ Live+ societ+
(B) Food	Label+ product+ Organic+ expensive Buy choice+ Read probably
(C) Nature	Intensive farm+ Mess+ nature Increase+ cancer+ Illnesses allerg+
(D) Science and politics	Keep quiet Find out Independent vested_interest+ Lack knowledge

Relationships between words and classes are mapped in figure 5.3. The classes 'nature' and 'science and politics' represent distinct clusters. In contrast, the clusters of the classes 'industry' and 'food' are partially overlapping, indicating that these topics often focus together in lay participants' discourse on GM food.

Figure 5.3 Focus groups: Correspondence analysis of characteristic words

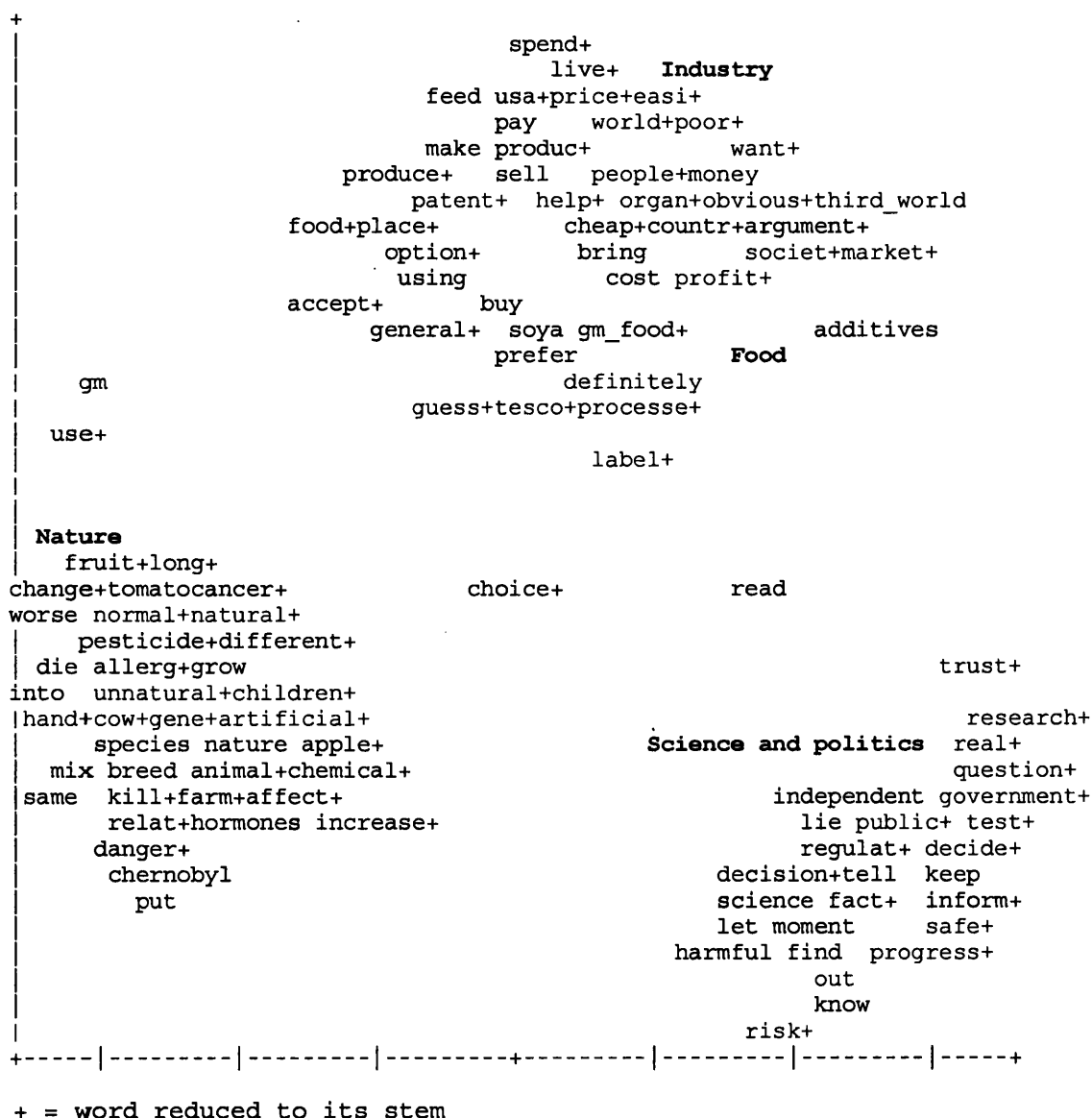
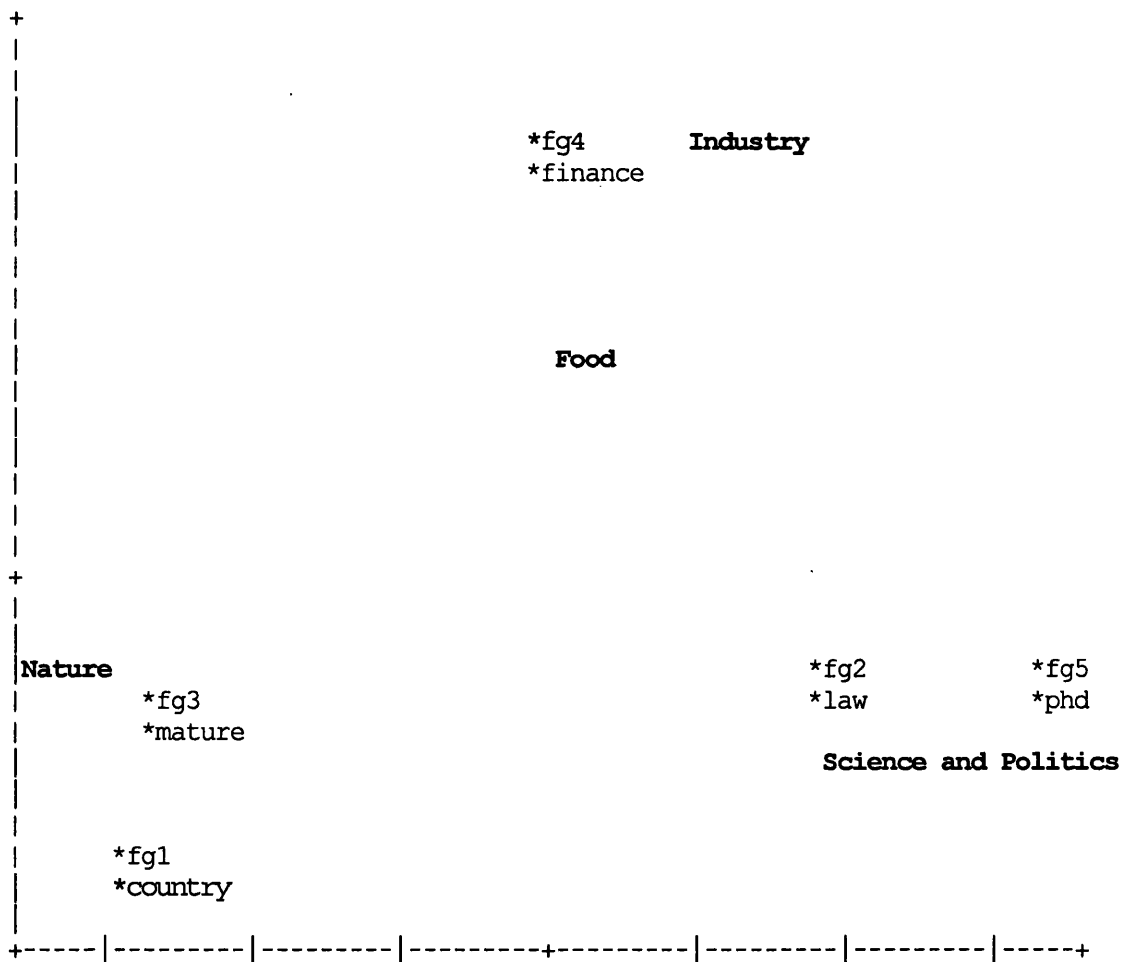


Figure 5.3 can then be superimposed by figure 5.4 to indicate which focus group are more strongly associated with which class. As could be expected, the focus groups

consisting of mature participants with children and of participants living in the country are most strongly associated with discussions about nature. On the other hand, the focus group consisting of finance students is more strongly associated with class A (industry) while the law group as well as the PhD group are associated with class D (science and politics).

Figure 5.4 Focus groups: Correspondence analysis of focus groups and lexical classes



To further contextualise the findings and to show how each word is used in the original text, table 5.7 shows the three most significant ECUs per class by strength of χ^2 association. For a complete outline of representative contextual units, please see Appendix C.

Table 5.7 Focus groups: Most characteristic ECUs in each class

<i>Class</i>	<i>Most representative ECUs per class</i>
(A) Industry	<ul style="list-style-type: none"> • 26 V: but it would still be a third_world country, it wouldn_t change that much. if they wanted to do it, they would have done it already. P: also, there are other ways of helping the poor, they could do it in another, better way. • 21 C_mon! P: in the end, they want to make the poor dependent on their products, their seeds, their crops, so they can make more money. I think saying _oh we will help the poor_ is just an excuse so that people accept all that stuff S: and even the poor countries are rejecting gm there must be a reason for it! • 20 I think they_re producing it for a reason, and that reason is not to help the poor. Maybe it will benefit the poor as well, but that_s not the aim behind it I think SG: that_s just a selling technique S: they_wouldn_t bother spending all this money on research, on persuading the public, etc.
(B) Food	<ul style="list-style-type: none"> • 56 you know when I go to a tesco supermarket and I look at the ingredients and I tend to do that a lot it reads like a chemist_s prescription as opposed to a food store because it has loads of additives of all sorts of kinds. • 43 you buy tinned spaghetti, you can be sure they contain gm! V: I have one question: spaghetti is not made from soya bean is it? S: not yet! MW: but generally processed foods do contain gm. • 38 DI: if it was the same price would you buy it? C: then I would buy only organic. P: me too. I think all gm_foods should be labelled at least ALL: yes, definitely D: I want to have the choice.
(C) Nature	<ul style="list-style-type: none"> • 34 for example, putting a completely foreign gene, say from some animal into an apple I find totally unacceptable, for the reason that it is unnatural beyond belief it simply could not happen if nature had her way. • 25 and in the end we have super insects, super weeds. V: how dangerous is it for the fields, the grounds, will it change the soil content? Organic farming is different and much better than artificial, modified farming MW: I mean the fertilisers will be washed down in the ground and get into the ground water, and the more we have of them the worse it will be for our health. • 24 I just do not like that. it_s artificial to put these things into our animals, but that_s different from gm. MI: it_s different but both are unnatural. Milking a cow 24 hours a day, their tits start to grow bacteria on them, it_s horrible, leading to infection, this could transmit to humans.
(D) Science and politics	<ul style="list-style-type: none"> • 20 at the moment I do not know that and unfortunately we have a history here in the uk with the government not telling the truth. so why should I believe them now? it_s the lack of knowledge that scares you the most, the fact that you really do not know what_s in your food, whether it_s been modified, how has it been modified? • 16 DI: there isn_t any clear information. V: maybe not for us, but I think they know, they have the facts. DI: I do not know about that. I think there are just too many unanswered questions for all of us really. I do not know, perhaps there is more information on the internet. • 14 they knew well before that but because the tobacco industry is such a profitable industry they tried to keep it quiet. the same thing might happen with gm. S: yes, there_s so much profit involved that governments are unlikely to base their decisions purely on science facts.

5.5 Comparing elite interview and focus group findings

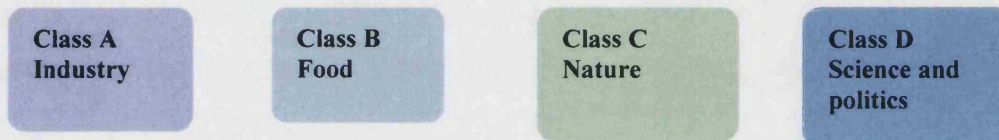
For clarity of comparison, figure 5.5 shows the overall ALCESTE classifications of both interviews and focus groups. For both groups, the largest class is concerned with the understanding of the public, science and politics (classes C and D respectively).

Figure 5.5 Expert and lay classifications

Elite interviews



Focus groups



It could be argued that both classes address the same issues albeit from different perspectives. For example, a positive view of science and its ability to solve problems is evident in experts' perceptions. Yet although science *per se* is generally not regarded as negative by lay participants the perceived interdependence of science, politics and industry and the lack of trust especially in the latter two may not allow for a positive evaluation of scientific developments in relation to GM:

"I think the real danger is the commercial aspect of the whole adventure. If it was pure science, done by the best independent scientists without vested interests, it would be much better, it might be something I could agree on."

(Male participant, 30, Focus group 2 'law')

In contrast, the smallest classes for both groups are those addressing specific risk and food issues (classes B), i.e. those dealing predominately with the science of GM, perhaps indicating their lack of relative importance when constructing representations of GM food risks. As such it appears that the actual risk assessment from a scientific perspective may not be the prevalent concern for lay participants.

Although both expert and lay participants address the environmental impacts of GM (in the classes 'environment' and 'nature' respectively) it is clear that lay people incorporate far wider issues in their representations than do experts. While experts mainly discuss the environment in relation to its physical dimensions and focus on GM in agriculture, lay participants represent issues in terms of a broader nature and value debate, and frequently discuss issues of "naturalness".

Experts address consumer issues such as labelling and consumer choice. These subjects are also discussed by lay participants yet topics related to 'industry' are more prevalent and debated in a far more animated way. So far, lay participants do not accept the promised benefits of GM food at all. Indeed 'feeding the world' arguments may have backfired. When focusing on consumer benefits, experts seemingly neglect the predominantly negative consumer sentiment towards those corporations offering the benefits. By contrast, focus group participants are not only concerned about consumer risks and benefits *per se* but also about societal power relations such as the American hegemony, the power of big corporations and the distribution of resources. The focus on US domination in discussions may partly have been due to the political climate in May 2003 (the Iraq war), as well as the fact that Monsanto one of the best-known biotech companies is an American company.

It may be useful to distinguish expert and lay risk perceptions in terms of denotations and connotations¹⁷. While the denotation, i.e. the scientific risk *per se* may not be a major source of disagreement between expert and lay people connotations clearly differ. It appears that for lay people the word "risk" suggests far broader meanings beyond the scientific risk, and that denotations and connotations cannot be easily separated:

"I don't necessarily think GM foods are more dangerous than non-GM foods but I don't like these associations."

(Female participant, 31, Focus group 1 'country')

¹⁷ While denotation describes a direct specific meaning, connotation is the suggestion of a meaning by a word apart from the thing it explicitly names or describes (Webster's New Collegiate Dictionary, 1980).

Evidently, this is likely to have implications for risk communication efforts. From a risk communications perspective, it seems that only the smallest classes dealing with risk (elite interviews) and food (focus groups) respectively have been previously addressed. The largest classes concerned with the relationship of public, scientists and politicians have been recognised as problematic recently. As outlined in Chapter Two, improved communication efforts are being made. But because of the different ways that expert and lay people frame the issues, communications between scientists and the public are likely to be challenging in times to come.

When looking at expert classes A (*'regulation'*) and C (*'PUS'*), and lay classes A (*'industry'*) and D (*'science and politics'*) it becomes clear that regulatory issues are discussed by both expert and lay participants. This may indicate the need of actively addressing regulatory concerns in risk communications, for instance by making regulatory processes more transparent. Results indicate that lay participants were unsure (and generally sceptical) of current regulatory practises.

Moreover, the contents of the focus group classes related to *'industry'* and *'nature'* (classes A and C) are normally not addressed by risk communication efforts at all. Both classes clearly deal with other aspects than the scientific risk *per se*. Rather they are concerned with deeper values, for which positivist science is unprepared. However, these classes seemingly play a notable role for lay people in constructing representations of GM food risks.

5.6 Conclusions Chapter Five

In conclusion, the ALCESTE analysis offers a valuable first exploration of expert and lay data. By outlining and effectively summarising the discourse of both groups, the findings highlight various issues on which expert and lay perceptions of GM food differ significantly. In many aspects, expert and lay participants tend to frame issues in different ways. As could be expected, expert and lay people take different dimensions into account when discussing the risks of GM food.

While experts primarily speak about the scientific risks *per se*, lay discourse does not focus on the scientific risks in isolation but rather incorporates the related broader issues in which the controversy is set. For example, concerns about nature and naturalness in relation to food consumption and food production seemingly play an important role for lay participants, but not for experts. In turn, this indicates the potential importance of social and societal dimensions in lay GM food risk representations.

Moreover, the importance of the clusters concerned with the relationships of the public, science, politics and industry for both groups may imply that expert and lay participants alike perceive a need for improving communications. On the one hand, experts view the relationship of scientists and the public as problematic. On the other hand, lay participants are suspicious of the interplay of science, politics and in particular industry.

These issues are discussed in detail in the following chapter which provides an in-depth analysis of expert and lay GM food representations, and presents both groups' mental models of the risk.

6 EXPERT AND LAY MENTAL MODELS OF GM FOOD

This chapter presents our expert and lay mental models of GM food constructed with the software Atlas/ti. We briefly introduce Atlas/ti and explain the development of our coding frame before presenting the results.

In line with the previous chapter, findings of expert and lay participants are discussed separately before a comparison is drawn. Expert and lay mental models of GM food risk are presented in the form of influence diagrams, which show clear divergences in risk representations in relation to various central concepts, such as health risks and perceptions of benefits. A particular distinguishing factor is lay participants' concern with various non-scientific issues which are not addressed by the experts.

In this sense, the findings show up the limits of the CMU approach to risk communication. While the CMU approach may be a useful tool to compare divergent risk perceptions, it does in effect not go far enough as it neglects any issues apart from the science *per se*. Having a rather cognitive perspective, it is in many ways too rational to address lay participants' concerns. To illustrate these limitations we focus on two areas that cannot be addressed through a science-based risk communication as suggested by Granger Morgan et al (2002), namely trust- and value-related concepts.

An important value-related concept is '*messing with nature*'. As it is a concept which has until recently been neglected in research, it is addressed in detail here. Our Atlas/ti analysis firmly establishes '*messing with nature*' as a major dimension of lay people's GM food risk representations. But the results also highlight the need to further examine what lies behind this concept, and what participants actually mean when they judge GM to be '*unnatural*'.

6.1 A theoretical background to Atlas/ti

Following from the exploratory ALCESTE analysis which helped to establish general discursive categories, Atlas/ti was utilised to investigate the particularities of expert and lay discourses of GM food risk in detail.

Atlas/ti (developed by Muir in the 1990s) is a powerful coding tool for the analysis of qualitative data, which can help to uncover phenomena hidden inside the data in an exploratory way. Barry (1998) suggests that utilising Atlas speeds up the coding process, and provides a more complex way of looking at relationships in the data. Also, by providing a formal structure for writing and storing memos, it aids conceptual and theoretical thinking about the data (Barry, 1998). The package is able to perform 'code and retrieve' type operations, cross-referencing via hyperlinks, text searches, and the creation of visual code networks (Kelle, 2000).

The latter characteristic is particularly useful for the creation of mental models, as previous work by Niewoehner (2001; 2002) has shown. The networking feature of Atlas/ti allows the researcher to visually connect selected passages, memos, and codes by means of diagrams. Thus it can show a concept or construct based on visible relations. In Atlas/ti, networks break through the structural confines imposed by linear text, and thus allow for a better exploration of the texture of the data and the interwoven meanings (Barry, 1998).

As with most analytical tools for qualitative data analysis, there is the potential downfall of becoming distanced from the data itself, or that qualitative data might be analysed in an unsuitably quantitative way. However, firstly, Atlas/ti has been specifically designed to keep the focus on the data itself (Barry, 1998). Secondly, it is clearly not possible to analyse data without reading and being familiar with it to begin with. In that regard, Atlas/ti only provides assistance in the thinking and analysis which is, and always has been, the job of the researcher (Kelle, 1997).

Regarding the triangulation of the methodologies ALCESTE and Atlas/ti, it can be argued that both are complimentary. While ALCESTE offers an excellent quick outline of the complete data set, Atlas/ti can offer an in-depth and detailed analysis, whereby it is possible to focus on particularly relevant topics and concepts at length.

6.1.1 Analytic procedure: Atlas/ti

The analysis of qualitative data is not simply a neutral process but rather an essential part of the construction of the research reality (Flick, 1998). Coding a data set means constructing the studied reality in a specific way. In order to be able to code text into identifiable categories, it is necessary to have operationalisations of the concepts of interest. For the present analysis these were not only provided through our theoretical background, but also through the ALCESTE analysis discussed in the previous chapter. This means that, as a first step, the transcripts had been coded automatically according to the co-occurrences of words rather than being influenced by the researcher. The general discursive clusters identified by ALCESTE grounded the development of the coding frame.

The coding scheme is intended to have heuristic value in interpreting the data rather than its codes 'becoming' the data to be analysed. Thus no codings are dependent on the presence of specific keywords or phrases. This is essential in order to enable the analysis of discourse that not only explicitly denotes a particular theme or concept, but also discourse that may only implicitly denote it (Allum, 2004). In accordance with Allum, the simplest and most all-encompassing working definition of risk was used. For the purpose of coding, risk was defined as

"Talk concerning some negative outcome in the future that has some degree of uncertainty attached."

(Allum, 2004; p.109)

6.1.2 Development of the Atlas/ti coding frame

Familiarity with all transcripts was gained through the transcriptions themselves and through re-reading the texts. Expert and lay data were coded separately, both with the following procedure.

Transcripts were coded iteratively using a hierarchical structure where super-ordinate themes ('principle codes') such as '*risk*' were coded with sub-themes ('thematic codes') such as '*risk unknown*'.

In order not to have an excessive number of sub-codes, several code families were compiled. As an example, the expert code *'benefit consumer'* incorporates the merged sub-codes: *'better food quality'*, *'better taste'*, *'cheaper food'*, *'enhanced vitamins'*, *'greater food choice'*, *'health benefit'*, *'lengthened shelf-life'*, and *'nutritional benefits'*. With regards to the focus group data, the code *'risk health'* for instance was compiled out of the sub-codes *'cancer'*, *'allergies'*, *'obesity'*, *'death'*, *'viruses'* and *'genetic mutation'*- all health-related issues that lay participants associate with GM food. For both groups, the code *'previous UK food scares'* comprises the merged sub-codes *'BSE'* and *'foot-and-mouth'*.

The basic unit of analysis was a single turn of a participant speaking (focus group) or a thematic utterance of the interviewee (expert interview). However, Atlas/ti does not require the researcher to pre-specify any particular length of analytic unit, and at times, several short turns were coded as one. An unlimited number of codes could be attached simultaneously to any fragment of text, hence individual text segments are frequently assigned various codes.

It was ensured that codes were matching when expert and lay participants addressed the same concept. For the purpose of analysis, memos comprising a selection of the actual quotes were attached to each code to remind the researcher of how a particular concept had been addressed by participants. These showed for example, that while both groups discuss the potential economic benefits of GM food, experts tend to speak about those in a positive manner while lay participants generally view those in a negative way.

When interpreting the focus group data, the entire episode was considered holistically and it was recognised that responses may have been subject to social influence (such as compliance), and not necessarily stand-alone statements, as the whole is often more than the sum of its parts (Gaskell, 2000).

Moreover, questions that arose during the analytic procedure (such as about commonly occurring relations between discursive themes) were addressed by refining searches focused on particular codes. For example, noting that lay participants often

distinguish between different levels of genetic modification- or different levels of “foreignness” of genetic transfer- the focus group data was re-analysed, leading to the creation of the super-code ‘*acceptability*’, which addresses the boundaries of acceptability of GM. An outline of all codes and their respective frequencies in the elite interviews and focus groups is presented in the following sections.

6.2 Results Atlas/ti

In accordance with the CMU approach, the particular focus of the analysis are expert and lay divergences, leading to certain concepts being only treated briefly, while others (areas of strong disagreement that would need to be addressed in a risk communication) are discussed in detail. In line with the previous chapter, expert and lay results are first discussed separately, before a comparison is drawn.

6.3 Central concepts: Expert participants

As identified by ALCESTE, expert discourse centres on discussions of risk and benefit, the public understanding of science (PUS) and regulation in relation to GM food. All experts address the same topics (loosely based on the interview schedule), albeit from different perspectives. Thus although the interview data is fairly consistent between interviewees (as a marker for good qualitative research), one expert provides a notable exception. Expert 8’s perceptions tend to be more in line with that of the public rather than the other eight experts. For example, the question of whether GM is necessary at all (a major point of discussion in the focus groups) is addressed by this participant only. Table 6.1 present the frequencies of the primary and sub-codes for each expert interviewee (I) indicating how often the codings occurred in each interview and in total.

Looking at the number of total codes, it is evident that experts speak about the benefits of GM food far more frequently than about the risks, despite having been asked about both. Particularly, experts highlight the potential consumer benefits. The exacting dimensions of these benefits are shown in more detail in the expert mental model

below. This focus on consumer benefits might imply that the experts interviewed are actively interested in the utility of GM food for the western consumer. Also, it is notable that experts agree that GM foods are at least '*as safe as conventional foods*' for human consumption.

As indicated by ALCESTE, the public understanding of science is a significant discussion point for experts, with many experts focusing on the problems related to public perceptions of GM. Regarding regulation, table 6.1 shows that, with one exception, experts stress that GM is effectively regulated to date.

Table 6.1 Codes-Primary-Documents- Expert interviews

Codes	I1	I2	I3	I4	I5	I6	I7	I8	I9	Totals
Benefit										
Benefit consumer	5	8	18	4	12	16	6	0	14	83
Benefit economic	3	4	6	2	4	7	4	0	4	34
Benefit environment	2	4	5	3	5	6	6	0	4	35
Benefit farmers	1	10	10	3	5	8	8	2	10	57
Benefit third world	5	7	8	2	4	8	2	0	3	39
Scientific progress	0	4	3	0	1	1	3	0	4	16
GM science										
GM products	6	4	9	4	2	9	6	3	7	50
GM research problems	4	1	0	1	1	0	1	1	0	9
GM science <i>per se</i>	0	4	2	1	3	2	2	0	3	17
Sufficient research	0	4	1	0	3	1	6	0	8	23
PUS										
Media	0	3	1	0	1	0	3	0	4	12
Pressure groups	0	4	2	1	3	0	2	0	10	22
Previous UK food scares	1	1	3	1	2	1	4	1	1	15
Public perception	7	8	10	4	7	1	11	1	2	51
Science-policy interaction	3	3	3	1	2	0	2	1	1	16
Regulation										
Effective regulation	4	12	11	5	7	9	4	0	7	59
Industry	0	0	2	3	1	0	0	1	3	10
Labelling	0	1	2	2	4	2	0	0	2	13
Precautionary principle	0	2	0	0	2	0	0	0	1	5
Regulatory problems	0	0	0	0	0	0	3	3	1	7
Retailers' behaviour	0	1	2	2	0	0	0	0	0	5
Substantial equivalence	0	2	0	7	4	7	0	2	2	24
Risk										
As safe as conventional foods	9	7	1	1	15	8	10	3	13	77
Long-term effects	0	0	1	2	0	0	1	4	0	8
Risk assessment	1	1	0	1	0	2	5	1	2	13
Risk environment	2	1	5	2	0	0	5	12	0	27
Risk health	1	1	0	0	0	0	0	3	1	6
Risk unquantifiable	0	0	2	1	0	0	1	0	0	4
Scientific uncertainty	4	6	4	3	2	0	5	2	1	27
Values										
Criticisms organic farming	1	2	2	0	1	0	3	0	4	13
No solution to poverty	0	0	0	1	0	0	4	3	0	8
Technological solutions	1	4	3	0	2	1	3	2	4	20
Totals	60	109	126	57	93	89	110	47	116	807

In order to examine the relationships between these codes and contextualise them according to the CMU approach, figure 6.1 presents the expert mental model before the findings are discussed. The diagram was constructed as follows. In accordance with the CMU approach, to construct the expert mental model, we predominately focused on the scientific aspects of GM. However, in order to highlight areas of expert disagreement, we also include codes about regulatory problems, which are excluded in table 6.1 because of their very low frequencies.

As explained in the previous section, Atlas/ti allows the researcher to construct code families, e.g. '*benefit consumer*' or '*benefit farmer*'. The mental model in figure 6.1 shows in detail what these rather broad codings incorporate. Additionally, Atlas/ti provides a 'query tool' function which allows the researcher to further check how codes occur together in the dataset. It is then up to the researcher to establish the particular relations between the codes, and draw up a network of connections within the Atlas/ti networking function. The relationships between the codes are determined heuristically based on our knowledge of the interview transcripts, rather than by using set rules.

6.3.1 Expert risk and benefit

As shown in the mental model in figure 6.1 experts perceive far more benefits than risks of GM food. However, although experts agree that GM foods have significant potential benefits, there is disagreement of what these benefits are likely to be and when society may be able to enjoy them. Benefits can be divided into five categories: benefits for a) consumers, b) farmers, c) the third world, d) the environment, and e) economic benefits.

For example, the expert mental model shows that benefits for farmers include herbicide tolerance, and pest, fungal, virus and other disease resistance. Often, consumer, farmer and environmental benefit are perceived as interrelated:

“(GM) crops can grow with reduced pesticide inputs that has major benefits in terms of the costs of poor farmers, and that works even for small-scale farmers, and it has benefits for the health of farm workers, because they are not having to deal with as much pesticide application, and it has economic benefits as well as having benefits for the environment.”

(Expert 6)

Speaking of health benefits (such as nutritional benefits) for the western consumer, experts admit that these (although in the research pipeline) are not fully developed yet, with their market introduction still distant.

Regarding the controversial issue of whether and how GM can help to solve problems of starvation in third world countries, experts largely agree that GM is not the only solution to these problems, but that it can (and generally should) play a significant part. There is wide-ranging agreement of the usefulness and necessity of providing technological solutions:

“You know it is poverty, and wars and corrupt governments and all these sort of factors, and it is a huge complex problem. But it won't be solved without science, no matter what you do in other respects! It won't be solved without science simply because the increase in world population in the next few decades which is said to double by 2050, most of the increase being in the developing and the poorest countries. There won't be enough

land and enough water by conventional means. So this is the reason why GM is an essential contribution to the future.”

(Expert 2)

Yet in contrast, Expert 8 argues that in relation to poverty, GM foods may actually pose a risk because:

“Hunger is about poverty and one of the big concerns is about private interests controlling food and food production. It will not help food poverty but could intensify it. So quite how that’s going to help world starvation is beyond me really.”

6.3.2 Health risk

Strikingly, our experts generally frame discussions about GM food risk in terms of safety, providing a more positive reference frame. Regarding human health, there is agreement that GM foods are at least as safe as any other novel conventional foods, and that they do not pose any additional human health risk. Often, a comparison between conventional plant breeding and GM is drawn. It is argued that while thousands of genes may be transferred in the former, the latter can be much more focused transferring only particular desired genes at any one time and hence is less risky. As such, the risk of allergenicity is judged to be no higher than with any other novel food:

“I often say that if I go out and have a Thai meal I can guarantee that I’m eating more foreign DNA- if you like to put it like that- more DNA than my body has not seen, than if I eat any amount of Monsanto maize or soya-bean.”

(Expert 5)

On the other hand, Expert 8 disagrees about the risk of potential allergenicity:

“I think because when you take a gene and it brings an allergen with it, it is so devoid from the original food that it is actually completely different from any other type of allergen that may be introduced as the result of conventional breeding.”

6.3.3 Environmental risk

But there is accord that food safety is much easier to ensure than environmental safety. Regarding the environment, there is clear potential for adverse effects- however, experts disagree if and how detrimental GM crops may be. First, effects are difficult to predict due to the lack of lengthy field trials to date. Second, there is the question of what exactly constitutes harm to the environment. For example, there is the risk of pollen transfer:

“The reality of farming means, the reality of pollination means, that if you have GM crops in the countryside, they will cross-pollinate with organic crops from time to time, at unpredictable levels.”

(Expert 7)

Yet is any change harmful or where do the boundaries lie? Here, risk assessment requires a value judgement. This is a fact neglected by the CMU approach. Although the approach appreciates that there may be divergent expert opinions, it does not offer any strategies of how to deal with what are effectively different social constructions of reality.

On the one hand, it is suggested that GM crops may be damaging to biodiversity because

“With herbicide tolerance the risk is that you have completely clinically clean fields everywhere, not a weed in sight. You can do that. Now that would be very damaging to biodiversity. So that’s quite a high risk.”

(Expert 7)

On the other hand, GM crops are unlikely to be more damaging than other non-native species. Expert 3 suggests that:

“There is far more environmental damage done caused by the introduction of non-GM organisms. So for example, you have a history of the introduction of non-native species into almost every country in the world. Nine times out of ten there are no problems, but roughly in ten percent of occasions there are real problems.”

While GM is generally perceived not to present any additional risk, experts also agree that there is no zero risk, whether in relation to GM or anything else in life. The request to quantify GM risk was declined by all, meaning that rather than a quantitative influence diagram as suggested by Granger Morgan et al (2002), current results are presented heuristically, showing potential risks (and benefits) but not their likelihood of occurrence.

One of the reasons experts decline to quantify the risks of GM food is because there are various issues of scientific uncertainty, especially related to the environmental effects. And contrary to popular belief most experts have no problem in admitting to it:

“There is always a very high degree of provisionality about scientific findings, they are almost never set in stone.”

(Expert 3)

However, experts are much more accepting of this than the public, possibly because of their particular scientific knowledge, and their higher trust in regulation. This in turn may be the result of their knowledge about regulatory practises in relation to GM, as well as the fact that several experts interviewed had served or are currently serving in the UK government regulatory bodies.

6.4 Regulation

Overall experts express strong trust in the UK regulation of GM science. The prevalent opinion is that the regulatory mechanisms currently in place in the UK are effective, albeit clearly not ‘foolproof’ as such, as no regulation can be ‘absolutely safe’. There is strong trust in both the ability of experts’ knowledge as well as their motivations:

“Well, ACRE here in the UK works in my view very well. It has a large number of people who sit on it. They have a very wide range of expertise, in molecular genetics, in ecology, in food safety, very very wide range of expertise. And by and large they have no vested interests. They have been picked specifically so that they do not actually have any particular com-

mercial interests in GM crops. That was not the case five years ago but it's the case now. I think they're very reliable, they take their responsibilities very seriously, the quality of the information that they require from the industry is very high, and they often send applications back to Monsanto and others, saying 'we do not believe this, we do not think you've done it properly, tell us the real truth about this...'. They often get some bad science, some sloppy science in applications, they spot this immediately. So I have a lot of faith in the regulatory system in the UK."

(Expert 7)

Interestingly a distinction is drawn to EU regulations, which are sometimes perceived as less trustworthy indicating that the public's suspicions may be warranted to some extent:

"I would not have the same degree of faith in the European regulatory system more generally, because I think that some of the regulatory committees in other countries are populated by people who have very strong vested interests"

(Expert 7)

Understandingly, this might be worrying since the risks of GMOs are not necessarily geographically bounded. Furthermore, it is remarkable because the EU had a major role in shaping GM regulations. Yet the above statement shows that there are UK scientists calling into question the competence of EU committees.

6.4.1 Regulatory problems: Labelling

There are some issues of significant expert disagreement, related to regulatory problems, such as the labelling of GM products, and the validity of risk assessments. Regarding labelling, experts agree that GM foods should be labelled in order to provide consumer choice, and that it is a necessary prerequisite for consumer acceptance. But there are problems of how and when a product should be labelled, and when a product should be considered a GM product, when it is an actual GM food (such as a GM tomato) or when it merely has some GM ingredient in it? This in turn is related to the

issue of traceability of GM, and what level of GM is acceptable in the UK as well as the EU:

“Labelling in principle is reasonable. Where I do think it becomes a problem is where you have this issue that there is no simple dipstick test at the point of purchase for the consumer or the food retailer to say whether something is indeed GM or not. And therefore I actually subscribe to the UK government view, which is not the majority view in the EU, to in those cases to try and then have a regulatory system based on traceability back is un-enforceable and is therefore poor law.”

(Expert 6)

6.4.2 Regulatory problems: Risk assessment

A further regulatory problem concerns the validity of the concept of substantial equivalence as a basis for risk assessment. Is it sufficient if the (end) GM product itself is substantially equivalent to a non-GM product, or should the process of product development be taken into consideration when assessing the risk? Here, experts do not agree at all. While on the one hand, the majority of experts do not see any problems with using substantial equivalence as a recognised method for assessing effects, on the other hand, it is argued that:

“I do not think substantial equivalence is valid. I think it needs to be looked at. Substantial equivalence isn't a good basis. You should be looking at what's different, not at what's similar.”

(Expert 4)

Again, risk assessment here seemingly comes down to a value judgement, hinting at the limits of a purely science-based risk evaluation. A further value-related area of significant expert dispute is the application (as well as interpretation) of the precautionary principle to science. Although the principle by itself is not criticised, there is the common perception that it can be taken too far:

“If we'd adopted that sort of approach we'd never have had a drug, we'd never have a chemical in agriculture, we'd never have done anything in terms of lifesciences. Here the precautionary principle is used irresponsibly.”

bly, totally irresponsibly! That's not to say we should not be cautious but we should do it through the normal regulatory channels, ask as many questions as possible."

(Expert 9)

In sum, although experts generally express strong trust in the UK regulations of GM foods, regulation is problematic, with expert opinions diverging on issues of labelling and risk assessment procedures. At present there are several key regulatory issues that still need to be resolved and it seems that these are value-related matters that cannot be resolved by science alone.

6.5 The public understanding of science

As indicated by ALCESTE, the PUS is a major discussion point among all experts, although, as the interview schedule shows, no questions were asked about this topic directly. This implies that experts do take this topic seriously, however, in several instances, experts' attitudes towards the public are still very much in line with the information deficit model.

6.5.1 Media, pressure groups and social perceptions

Experts credit the media, the organic farming movement and various pressure groups (such as Greenpeace or Friends of the Earth) with a huge amount of influence on public opinion, and in most cases, this influence is perceived as negative:

"But the options society faces are: do we do nothing? Do we stand still, do we ignore it? Do we follow what the Greenpeace folk want and just say we're so frightened of unknown unknowns that we do not make any progress?"

(Expert 9)

A common suggestion is that the media, together with various pressure groups, successfully launched a campaign against GM foods exploiting the uncertainties around the issues, effectively scaring the public. Several experts accuse pressure groups of being ill-informed, and of not offering any solutions, but only criticism. Likewise, the

organic farming movement is perceived to have used their lack of GM as an influential marketing strategy:

“They have said ‘all GM crops are the same. Everything that is produced by transgenic technology is bad and we will not have anything to do with it.’ That’s their marketing ploy.”

(Expert 2)

In this way, experts appreciate that lay perceptions of GM food are influenced by social rather than purely scientific factors. Expert 8 in particular recognises that the separation of the social and the scientific risk dimensions is not straightforward arguing that solely assessing the scientific risks of GM is insufficient, as there are other (deeper level) issues that require consideration, such as

“The underlying question is does anybody want them or do we need them, and what are the alternatives- that should also be part of the equation. Our feeling is that we need to look for more sustainable solutions and not try to look for technological fixes...Because it’s not herbicide tolerant crops or carry on as we are at the moment- that isn’t the choice that we face. We have other ways of doing agriculture.”

(Expert 8)

With this approach, this expert echoes the prevalent attitude of the public. Because these issues cannot simply be resolved by science alone as suggested by the CMU approach, the question of how these issues can be addressed, and how such types of value conflicts can be solved remains.

6.5.2 Public perception problems

As indicated through the ALCESTE analysis, the findings show that public perception is perceived as a real problem by most experts. It is appreciated that the public have been sensitised to food problems since the occurrence of BSE and foot-and-mouth. However, in contrast to the public, experts view previous food scares as exceptions, not as the norm, appreciating that the public only knows about regulatory issues when things go wrong:

"I am appalled at what the green party do, they say 'you can not trust this government, because look at BSE, look at foot-and mouth, and therefore you can not trust them on GM'. I just think that is appalling. Because all the normal government regulatory machinery, BSE was a surprise, and foot-and-mouth they should've dealt with better, but they are not the government regulatory machinery. The in place machinery like ACRE, like ACNFP, like AEBC, and so on, they've all done a brilliant job for years but everybody ignores that!"

(Expert 9)

The public's opposition to GM is often described as "*emotional rather than factual*" (e.g. Expert 5), indicating that the information deficit model still finds some validation today. Experts perceive the lack of public knowledge about GM in general as problematic:

"I find that the level of understanding of just fundamental genetics amongst the population throughout Europe is absolutely as low as it can get. Most people have not even the first idea of even what genes are or where they are or how they are. They know nothing about it really."

(Expert 7)

To conclude on the expert mental model, overall our experts perceive many more benefits than risks of GM foods. However, there are notable expert divergences as well, such as in relation to environmental risks and benefits. Further, although most experts have strong trust in the UK regulation of GM, there are several regulatory issues (often regarding the validity of risk assessment procedures) that still need to be resolved. Interestingly, expert disagreements are generally related to values, not the science *per se*. It appears that even experts, despite having access to the same scientific knowledge, choose risk representations that are in line with their values and interests, and that in many cases science cannot easily be divided from values. Hence just as there is not "one public opinion" there is not only "one expert opinion" either. Yet in turn, expert disagreements are problematic for the lay public, heightening for example lack of trust in science. These and other findings of the lay focus groups are discussed in the following section.

6.6 Central concepts: Lay participants

To begin with, it should be noted that the word risk *per se* is employed by lay participants together with the words 'danger' and 'uncertainty'. However, we remain with the term risk for the purpose of clarity and because it connotes both danger and uncertainty.

When lay participants speak about the risks of GM food, a different range of issues come into the equation. Table 6.2 shows the frequencies of primary and sub-codes for each focus group (Fg) indicating how often topics are discussed in each focus group and in total.

Table 6.2 Codes-Primary-Documents- Focus groups

Codes	Fg1	Fg2	Fg3	Fg4	Fg5	Totals
Benefit						
Benefit economic	13	16	7	26	8	70
Benefit environment	0	1	5	0	0	6
No benefit	7	4	4	9	1	25
Food						
Concern food production	35	12	14	4	6	71
De-naturalised foods	27	8	18	14	13	80
Food risk general	17	11	4	15	12	59
GM foods on market?	8	12	7	11	3	41
Organic farming	13	0	6	8	2	29
Previous UK food scares	9	2	4	7	3	25
GM science						
GM science <i>per se</i>	18	14	14	11	9	66
Scientific disagreements	3	7	0	4	2	16
Information/knowledge						
Lack of information	6	25	10	14	12	67
Lack of factual knowledge	20	14	7	11	7	59
Insufficient research	4	10	11	13	12	50
Regulation						
Lack of ethical framework	3	7	2	0	5	17
Regulation <i>per se</i>	22	30	6	9	9	79
Retailers' behaviour	7	7	1	2	3	20
Risk						
Long-term effects	8	7	4	14	6	39
Risk environment	16	9	17	8	13	63
Risk health	46	11	14	28	8	107
Risk invisible	0	1	1	1	2	5
Risk involuntary	10	22	16	25	15	88
Risk irreversible	3	3	4	6	2	18
Risk uncontrollable	4	0	0	5	3	12
Risk unknown	7	20	17	15	6	65
Risk unquantifiable	1	8	0	2	0	11
Risk of patenting	0	5	4	2	2	13
Scientific uncertainty	23	13	16	23	15	90
Science and politics						
Fatalism	3	8	3	11	9	34
Pressure groups and media	8	9	7	8	12	42
Public perception	9	2	6	2	7	26
Responsibility	4	4	1	5	5	19

Table 6.2 Codes-Primary-Documents- Focus groups (cont.)

Codes	Fg1	Fg2	Fg3	Fg4	Fg5	Totals
Science-policy interaction	14	8	4	5	14	45
Trust						
Suspicion/conspiracy	31	18	13	20	10	92
Lack of trust general	12	16	4	6	7	45
Lack of trust in government	13	16	8	10	1	48
Lack of trust in industry	36	18	19	19	24	116
Vested interests	16	10	7	14	12	59
Values						
Anti-americanism	0	2	2	0	12	16
Deeper level solutions	8	3	4	1	18	34
Equity	14	10	9	10	9	52
Future of the planet	36	11	12	11	7	77
GM will make things worse	21	3	4	12	7	47
Not necessary	6	8	10	15	1	40
Scientific progress	11	11	0	8	4	34
Technological solutions	8	7	2	4	1	22
Third world problems	13	10	13	24	12	72
Nature						
Idealisation nature	24	7	12	9	10	62
Messing with nature	39	19	15	32	9	114
Mixing genes	11	7	7	12	3	40
Acceptability (supercode)	15	12	16	14	8	65
Totals	682	497	391	541	381	2494

Table 6.2 shows that, in contrast to experts, lay discourse centres on the risks rather than the benefits of GM food. Of particular concern are the potential health risks of GM, and the fact that the risk is involuntary. The uncertainty in relation to the science of GM is repeatedly mentioned and viewed with unease. Moreover, discussions recurrently focus on trust-related issues, whereby the lack of trust in industry is most pronounced.

Also, it is clear that in contrast to experts, lay participants frequently discuss non-scientific issues, such as those related to ‘values’- examining whether GM is necessary, positive and negative sides of technological progress in general, and how nature and humanity should be treated. Hereby, participants often talk about the concept of nature in an idealised way, offering a contrast to GM which is perceived to be “*messing with nature*”.

In order to examine the relationships between the codes and contextualise them according to the CMU approach, figure 6.2 presents the lay mental model before the findings are discussed. The construction of the diagram proceeded as outlined in rela-

tion to the expert mental model in the previous section. For example, to provide more detail than in table 6.2 we show which codings are associated with the relatively broad code families, e.g. *health risk* and *environmental risk*. To explore the meaning of codes in their contexts, the relationships between the codes are determined heuristically based on our knowledge of the focus group transcripts using the Atlas/ti networking function.

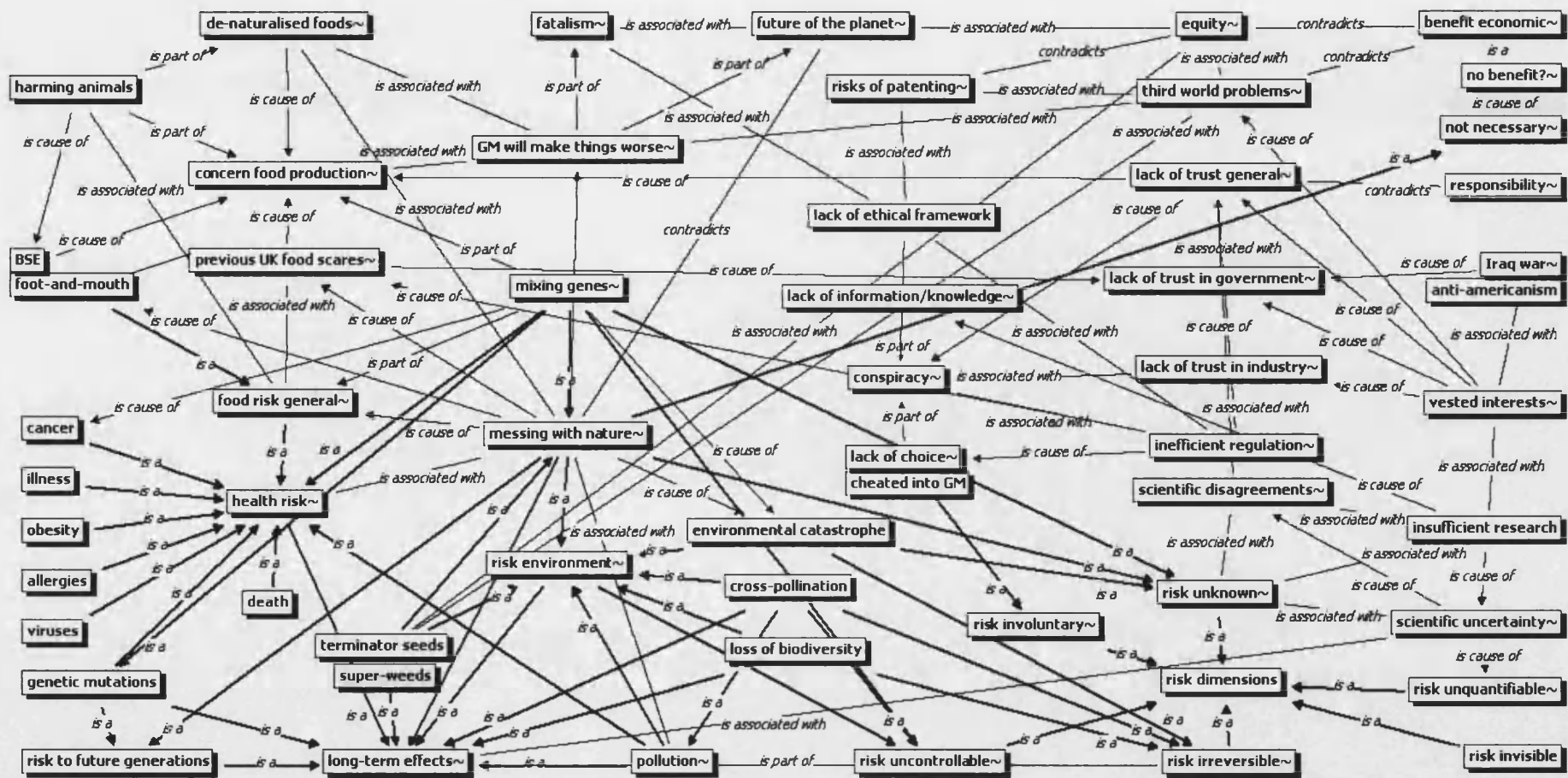


Figure 6.2 Lay mental model of GM food risk

6.7 Lay risk and benefit

The lay mental model in figure 6.2 shows that in contrast to most experts, lay participants perceive only very few benefits of GM food. Indeed, it is frequently mentioned that there are no benefits at all: *"I can't see any benefits at all, only risks really"* (male participant, 31, fg2). Nevertheless, risks and benefits are often weighted up. There is a feeling that there may indeed be short-term benefits, but that they are not worth taking a long-term risk for, at least as long as these risks are still unknown:

H: *"Nobody seems to know- yes they might say 'it will help the poor people and bring benefits for them' but what kind of risks does it bring?"*

E: *"That's the question: do the benefits outweigh the risks? I don't think so."*

(fg4 'finance')

Although some participants consider GM to bring benefits for the third world and help relieve starvation, most do not believe this, and indeed, this argument seems to have backfired. It is appreciated that there are significant economic benefits, but these are not viewed positively as the question arose for whom- generally this is assumed to be solely to the big companies' advantage. Often, these companies are viewed antagonistically, especially Monsanto which seems to be made a scapegoat.

Interestingly, benefits perceived by the experts are often not regarded as such by lay participants. For example, experts mention longer shelf-life of fruits and vegetables as a consumer benefit. But this is deemed unnecessary and unwanted by the public:

"They say GM can make fruits last longer without getting squashy, and some people might see that as a benefit but I don't. I just think it's unnatural."

(male participant, 32, fg2 'law')

Essentially, lay participants disregard many of the benefits of GM foods outlined by experts and do not trust the motivations of the companies delivering the benefits. Participants acknowledge that they simply had not heard as much about potential benefits as about risks, and readily admit to confusion as to what was actually happening at the

moment. There is a lack of knowledge about what the benefits might be, and how realistic they are. Thus not only are different risk perceptions of expert and lay people cause of controversy, but equally, different perceptions of benefits. Termed the “mis-perception of risk perception” Gaskell et al (2004) argue that at the heart of the GM food controversy is not the mis-perception of the scientific risks, but rather the perception of absent benefits. In turn, the relevance of risk communication strategies such as the CMU approach which aims to change public risk perception by focusing on the risk *per se* is questionable.

6.7.1 Health risk

In stark contrast to experts, most lay participants perceive GM foods to have significant health risks. As shown in the mental model in figure 6.2, lay participants are strongly concerned that GM foods may lead to illnesses, such as cancer, obesity, allergies, the creation of new viruses, and even death. The effect may not be immediate but certainly in the future and for future generations. Cancer is one of the main health concerns, and one that many participants are certain about. Yet the risk of cancer and other health risks anticipated by lay participants is not mentioned at all by experts, who consider GM foods to be ‘*as safe as any other novel food*’, maybe (but very unlikely) with some potential allergenicity.

Also, the risk of genetic mutations is discussed, and in a pseudo-scientific way it is suggested that GM may lead to handicaps:

“If you change genes it is likely to be very dangerous. Look at how we evolved- nature made everything perfect, we’re not supposed to mess with it really. For example, you know that a lot of children, or people in general are handicapped because of some genetic defect- do we want to increase that with genetic modification?”

(female participant, 30, fg1 ‘country’)

It seems that participants are not aware of the contradictions in the above in statement- if nature worked so perfectly why would we have genetic defects in the first place?

Yet despite the high perception of health risks, most participants are aware that compared to other risks frequently taken, such as smoking, health risks of GM food are not likely to be greater- hence the difference here is the voluntariness of risks and the lack of choice in relation to GM. A further question that often comes up concerns the quality and quantity of the risk, such how much can one eat, maybe a little bit is not harmful but where do the boundaries lie? Is it more harmful for certain population groups (such as for children) than for others? Therefore, contrary to suggestions in the literature of food in general (e.g. Zwart, 2000), our lay participants do not necessarily make a binary distinction between the safe and the unsafe but rather are aware of possible nuances on a continuum from unproblematic to problematic food.

With regards to health risks, variations in lay people's knowledge are especially pronounced and there is often confusion as to how potential health risks might manifest themselves:

“They're playing with the genes and the genes they use are not advanced. I hate that. There're all kinds of different genes out there and some people have genes that are coming from quite far back and the scientists change that and that can be really dangerous. That's why they've got these allergies, there're always new genes coming along and the body can't cope with that, some people can die from that. That's where cancer comes from because it comes from basically pollution and chemicals. Your body can't cope with all these chemicals, and genes are even worse.”

(female participant, 31, fg1 'country')

In that way, as implied by some of our experts, the concern with health risk is at least partly related to the limited knowledge of what genes are. The perception often is that one puts something strange into one's body, something foreign that should not be there. Thus when speaking about how “bad” genes are, it is likely that participants mean foreign genes, not simply genes *per se*.

6.7.2 Food risk general

As shown in the lay mental model, a part of the perceived health risks is the concern with food risk general, which in turn is associated with previous UK food scares and concern with modern food production methods. Both BSE and foot-and-mouth are

perceived as major food crises in the UK, and are frequently used as a comparison to GM. With all issues, the risk is not only involuntary, but felt to be forced upon society as “we all have to eat”. Moreover, previous food scares evidently contributed to the lack of trust now shown in relation to GM foods. The fact that a politician (Gummer) fed his daughter British beef in the midst of the BSE crisis is repeatedly presented as ‘evidence’ for politicians’ lack of knowledge and hence well-placed mistrust.

Likewise, previous food scares are often perceived as an indication of things to come, and there is great concern with food production methods in general. Specifically, this relates to intensive farming techniques and the way farm animals are treated. The prevailing perception is that GM will make an already bad situation even worse:

“We’ve seen already what all these kinds of intensive farming can do to us! Remember what happened with BSE and CJD? It’s a dangerous way of farming and I don’t agree with that. I think GM just will make all these issues worse, and there’s already so much wrong with farming, it’s far too intensive and that’s why we’re getting all these illnesses. We don’t need GM technology to make matters even worse.”

(male, 38, fg1 ‘country’)

Hence it is accepted that GM is certainly not the only problem, but rather a warning sign of the problems of modern food production and humans’ treatment of nature and of the environment in present times:

“In a way I wonder, this issue is not just about genetically modified food, it’s about how the food that we eat is tampered with in a way that is not natural.”

(male, 32, fg5 ‘PhD’)

Thus our findings raise the question of whether food risk today is in some ways a special case for risk communication interventions. Food in general is perceived as precarious because of previous food scares in the UK, and there is significant concern with current food production methods, often viewed in relation to de-naturalised foods on the market. The latter is a particularly significant part of the perception of general food risk and addressed in more detail under the section ‘natural versus unnatural foods’.

6.7.3 Environmental risk

Moreover, despite lacking detailed knowledge, all lay participants are deeply concerned about the potential environmental risks of GM. Most pronounced when speaking about environmental risks, is the irreversibility of the risk and the fact that effects may be slow to show, and that when they do it may be too late to remedy them. Echoing the dimensions of Slovic's (1987) psychometric paradigm and anchoring risks technologically (rather than food-specifically as above), GM and its effects are perceived to be like radiation:

"I think it's like radiation, you have no control over it, somebody else is making all the decisions, you can't see it, you can't smell it, and it will be here for years to come, these are the problems."

(female participant, 45, fg3 'mature')

Also, the risk of GM is dreaded in the way that participants often expect some kind of resulting future disaster to happen:

"At the moment, maybe nobody is harmed at least not directly, but what about future generations, what about the environment, biodiversity? GM might be another Chernobyl waiting to happen!"

(female participant, 30, fg3 'mature')

Reflecting Beck's (1986) definition of post-modern risk as knowing no boundaries in space and time, participants are strongly concerned about the longevity and distribution of GM risk.

A specific environmental risk commonly mentioned is the risk of cross-pollination. As with genes in general, there is the common assumption that GM plants and crops would "behave" in a different way than "normal" ones. It is perceived that pollen can go everywhere, and in the case of GM pollen, this is viewed as '*contamination*' and '*pollution*':

"I worry very much about cross-contamination of plants, the seeds of GM plants can waft miles into other territories of fields which are not GM and that's polluting them then."

(male participant, 29, fg2 'law')

Additionally, participants are concerned about the reduction in biodiversity as the result of GM:

"On the one hand, there was a big story in the news a couple of years ago saying that GM kills butterflies, and I think that, and basically killing any kind of species is obviously a great risk to the environment. On the other hand, apparently now they say that wildlife flourishes in GM fields, more so than in normal fields even! This clearly would be a benefit of GM, but whom do you believe to tell the truth?"

(male participant, 32, fg2 'law')

The above quote indicates that participants are also aware of potential environmental benefits of GM. For example, the decreased use of pesticides and fertilisers is occasionally mentioned. Still, while not favouring the use of pesticides, participants prefer those to the use of GM, for the reasons that a) they are familiar and their risks are known, and b) they are added to the food rather than changing the essence of it. Moreover, the question that often comes up is who to believe to tell the truth? Participants are confused by the mixed risk and benefit messages they feel they are receiving. Since potential environmental risks and benefits are also a significant area of expert contention as shown in the expert mental model which indicates both possibilities, lay participants' confusion is not surprising.

In sum, although expert and lay divergences in perceptions of health (and to a lesser extent environmental) risks could be addressed by providing further information in accordance with the CMU approach, the fact that previous food scares have destroyed lay participants' trust in government may be a barrier to effective communication. Further, concerns arise in part through non-technical risk issues, such as the involuntariness of the risk. These are issues that could not be addressed in a risk communication according to the science-based CMU approach. The following sections further

highlight the limitations of this approach to risk communication by focusing on lay concerns about scientific uncertainty, trust, and value-related issues.

6.7.4 Scientific uncertainty and scientific disagreements

In contrast to expert participants, scientific uncertainty and scientific disagreements are perceived as particularly problematic by lay participants. The perception is that even science at the moment is unable to answer the questions that they want to know about. The concern is less about the quantity of the risk, i.e. the fact that the risks are not quantifiable (as experts agree), but rather about the quality, i.e. what the risks might be, which is perceived to be completely unknown. Hence the main concern is about unknowable risks:

“I wouldn’t even trust the scientists, even if they really think they’re doing it for the right reasons, ok maybe now the research shows GM is not harmful, but they cannot know what’s going to happen in the future. They really cannot know and that’s the main problem. They might be the best expert in the field but they are not prophets- you know what I mean! In that way they don’t know more than us at all.”

(female participant, 35, fg1 ‘country’)

Often, more research is called for to combat at least some of the areas of uncertainty. In contrast to most experts’ perceptions, there is strong agreement that the research to date is not sufficient, and that far more longitudinal research needs to be done in order to be able to adequately assess the safety of GM foods. The minimum time span for further research is often set at twenty years:

“Because it will stay with us forever I don’t think twenty years of further research is too much to ask!”

(male participant, 27, fg4 ‘finance’)

Yet participants are acutely aware that the research that they feel needs to be done could not be done in practise because it is unfeasible to conduct studies over such long time spans, and that politicians would not wait that long to introduce GM.

Apart from scientific uncertainty, a further cause for concern for lay participants, are disagreements between experts, often played out in the media. There is the feeling that clear-cut knowledge does not exist, hence participants do not know whom to believe. Contrary to experts' beliefs, participants realise that pressure groups also have their own agenda, and do not trust them blindly. Additionally, since science is constantly evolving, many find it impossible to keep up with all the new developments. This is not restricted to GM foods though, but to wider food issues:

"The problem with food is also that you don't really know anymore what is good for you and what isn't. These so-called facts seem to change all the time, even with non-GM food. And with GM I can see no agreement at all, some say it's not harmful others strongly disagree."

(female participant, 27, fg2 'law')

In essence, the perception of GM food risk as both unknown and unknowable is worrying for lay participants and clearly not an issue that can be easily resolved by science alone- who should decide when GM foods can be declared safe and for whom? It seems that a pre-requisite of accepting scientific uncertainty is trust in the responsible agents, yet today well-publicised expert disagreements are contributing to a lack of public trust.

6.7.5 Trust

As can be seen in the lay mental model, trust, or lack of, is a major issue of concern for participants. Nevertheless, in the present study, it is addressed relatively briefly, because as outlined in Chapter One, it has received copious amounts of attention in the literature, and overall, the present findings confirm previous results. Apart from lack of trust in general, lack of trust in government/regulation, and in industry, the media is not trusted to tell the truth either. This leads to participants often feeling conspired against. Hence the problem may not be just lack of trust but an actual culture of suspicion and fear. In turn, this raises the question of whether risk communication problems can actually be solved with the CMU approach alone.

6.7.6 Vested interests of science, politics and industry

Lay participants are deeply concerned that they cannot trust anyone, whether government, industry, scientists, the media, as well as pressure groups. They mistrust any particularly strong claims, whether made by government or pressure groups, and frequently call for more balanced information and the admission of uncertainties. Participants do not necessarily expect experts to make definite judgements, but remark that experts do not want to admit to uncertainty.

Yet evidently it is not simply the uncertainty inherent in scientific research that is problematic, but rather the motivation of scientists and their interplay with industry and politics. There is a strong perception of industry bias, and of (undeclared) vested interests. The underlying assumption is that politicians cannot be trusted to tell the truth- about GM as well as other issues. Hence lack of knowledge and information is seen as particularly challenging in relation to the extent to which confidence in government is justified:

S: "The trouble is, if you don't know anything you don't know whom to trust. You just have to make this decision without the relevant information..."

B: "It's the wider environment of trust, corporate trust and so on. It's not just to do with scientists, look at Enron, look at the scandals surrounding the Iraq war. Trust now is at its lowest. There's a crisis of trust in institutions, not just science I think."

(fg5 'PhD')

It is clear that just as risk cannot be seen in isolation, neither can trust. Trust in the UK government has deteriorated for a variety of reasons, such as the Iraq war and BSE. This illustrates the asymmetry of trust: once trust is destroyed, it is difficult to regain (Luhmann, 1979). Participants are aware that scientific advice turned out to be wrong in the past, and hence do not feel warranted to place their trust.

Interestingly, Barber's (1983) tripartite conception of trust (value compatibility, fiduciary responsibility and technical competence) is resembled- debates focus on either values, responsibility and motivations, or technical competence and capabilities of relevant authorities. Concerns arising from lack of trust are more often expressed in

relation to the motives of actors rather than their capabilities. The common perception is that scientists, government and industry stick together and depend on each other, and hence cannot be trusted as money will determine the outcome in the end:

“The scientists might be the best in their fields, but they are dependent on the companies to provide them with research grants. So they are not independent at all, in fact, some of them even have shares in the biotech companies! Moreover, the government is also dependent on the big companies to some extent- they need their investment.”

(male participant, 32, fg3 ‘mature’)

6.7.7 Lack of trust in regulation

Lack of trust in regulation is associated with the perception of regulation as inefficient and irresponsible. Lay participants are strongly concerned about who has responsibility for decisions, and who is to blame if things go wrong. There is a feeling that the agents responsible cannot be trusted to have the public’s best interests at heart, and that they will carry on regardless:

G: “So where should we stop and who is responsible? The scientists or the politicians? When things go wrong they just start blaming each other, that’s how it usually goes. So it should be decided now who is responsible, and how far we should go with this technology. Just because science allows us to do something doesn’t mean we should do it”

M: “That’s a question that nobody asks- when and where is it going to stop? They should discuss that now and make some guidelines at least. At the moment they have no guidelines I think and society has to decide now, before it’s too late, where to stop with this technology.”

(fg1 ‘country’)

Speaking about the “devil’s doctrine” in science, there is a general feeling that in science “what can be done, will be done” and participants are fearful of the repercussions. There is little trust in regulation being able to stop this process. In contrast to most experts, participants also strongly criticise the lack of ethical framework available and there is the feeling of technology going out of control, partly as the result of insufficient regulation in place. In contrast to most experts, lay participants have little

trust in the current regulatory regimes, and also appreciate that they lack knowledge, highlighting the importance of transparency in decision making:

“I don’t know anything about GM regulations, maybe if we would know then we could understand how decisions are made.”

(male participant, 34, fg2 ‘law’)

Maybe because of their lack of detailed knowledge about regulations, concerns of lay participants are often related to the lack of choice and the lack of information with regards to food purchases. Regarding the lack of choice of food products, participants question what constitutes a GM food product according to the current guidelines- a question that experts also disagree on. There is resentment about being ‘cheated into’ eating GM foods, with lack of choice being one of the main features of GM resistance:

“I want to have disclosure, I want to be able to choose, I feel like I am being cheated into buying something I do not want to buy. Whether it’s going to be damaging is a different matter, but we should be allowed to choose.”

(male participant, 32, fg5 ‘PhD’)

Lay participants question which (if any) GM foods there are currently on the market, as they feel unable to find out. Some argue that most of the food we eat is already GM, while others assume that there is no GM food on the market yet. This confusion is not surprising since even experts are unable to agree on whether GM foods are actually on the market as it depends on how a GM food is classified. As such, questions related to the definitions and characterisations of GM food may need to be first clarified by scientific experts in order to be able to effectively communicate with the lay public.

6.7.8 Conspiracies and lies

The lack of trust in the agents responsible to do the right thing, coupled with the perception of vested interests, may be described as suspicion, rather than simply the ab-

sence of trust. Participants are suspicious of being conspired against, by the government and by industry:

“We have to stop it if we still can, but probably we’ve been eating this stuff since ages and nobody told us. They like to keep these things secret because they know it could be dangerous.”

(male participant, 38, fg1 ‘country’)

Some participants perceive past failures in risk assessment as blatant “lies” warranting their lack of trust. The feeling of being conspired against and lied to, and of powerlessness against big institutions breeds resentment, often culminating in resignation and fatalism:

“People might disagree but the government just goes on regardless...Personally, I am against GM, but I feel there is nothing we can do. They talk about participatory democracy, but let’s face it: we don’t really have anything to say here.”

(male participant, 31, fg2 ‘law’)

Hence the findings highlight the difficulties of the relationship between the public, science, politics and industry. Arguments often explicitly or implicitly employ the concept of trust. As GM is not seen as being under the public’s control, there is an evident need for trust. Also, the public generally does not have access to all expert knowledge that would allow them to evaluate the risks themselves. Under these conditions, lack of trust in scientists, industry and government is a key problem. Lay participants appreciate this, and thus are greatly concerned with the interrelationships and perceived vested interests of all groups. Importantly, these concerns cannot be adequately addressed by the CMU approach focusing solely on the scientific aspects on GM food.

6.8 Value-related concerns

When comparing both mental models it is evident that a major distinguishing factor between expert and lay participants is the inclusion of value-related issues in the lay model. Hence this is a further non-scientific issue, in addition to the trust-related concerns discussed above, which highlights the limitations of the science-based CMU approach. For instance, lay participants questions about whether GM is necessary at all and *'what world do we want to live in'* cannot be answered by science alone.

Looking at values related to nature, it is clear that lay participants generally perceive GM to be *'messing with nature'*, which contrasts with a common idealisation of nature and traditional food and farming practices. A first indication of what *'messing with nature'* means for lay participants is shown in the way in which participants frequently distinguish between different "levels" of GM. These attitudes towards diverse types of genetic transfer are discussed under the sub-section *'acceptability and monstrosity'*.

6.8.1 GM food is not necessary

Lay participants are strongly concerned about fairness and equity in relation to the third world and do not think that GM food would be an adequate solution to the problems of developing countries. Hence the necessity and expediency of GM is questioned:

"There's enough food in the world to feed everybody, we have so many surpluses already. It's the distribution of food that's the problem and I don't see how GM can alleviate this problem..."

(male participant, 30, fg5 'PhD')

In contrast to most of the expert participants, only very few lay participants acknowledge that GM might play a role in alleviating starvation. Rather, it is felt that other, deeper issues and long-term solutions needed to be addressed first, as GM would only offer a short-term scientific fix, distracting from the real problems. Hence there is the frequent call for deeper level solutions as it is acknowledged that the GM debate may

be only a symbol for the need to change attitudes towards global problems more generally:

“So maybe the real debate isn’t about GM at all, but it’s about ecology, how we deal with our planet, what kind of world we want to live in, how we treat consumers, the distribution of power.”

(female participant, 48, fg5 ‘PhD’)

Lack of belief in scientific solutions to societal problems, coupled with the perceived lack of benefits, contributes to GM food being considered as an unnecessary risk that could and should be avoided. Here, a consequentialist style of reasoning, which judges the rightness of actions according to the value of what follows from their performance, based on the possible benefits of GM is common. In many ways, the perceived lack of utility overrides concerns about risk:

“I don’t know about the risks but why do we do all that in the first place? Why do we experiment with our food, why does the government push it like that? We don’t need it and that’s it”

(female participant, 29, fg5 ‘PhD’)

6.8.2 GM is “messing with nature”

As indicated by ALCESTE, the concept ‘messing with nature’ is one of the major distinguishing factors between expert and lay participants. Often, lay participants romanticise and idealise nature, perceiving nature in nostalgic and even melancholic ways, with many wanting to get back to how things used to be:

“I think we should go back to our roots, your own garden, plant your own vegetables, do it all the natural way...”

(female participant, 48, fg2 ‘law’)

Food-specifically, there is the prominent distinction of how food is or is not supposed to be:

"I always order organic foods and am always glad to find insects inside, it means that the food has not been poisoned, that is has been kept as it was supposed to."

(female participant, 54, fg3 'mature')

In contrast, GM food is generally perceived to be "messing with nature":

"You know all this messing with nature, changing nature in unnatural ways, just because we have the technology doesn't actually give us the right to just mess with nature. Some things should be left alone. If we were meant to be different, if plants were meant to be with some other genes, then nature would have done that! In nature, everything has a place, everything works as it should work, we shouldn't take the risk of messing it up."

(female participant, 29, fg4 'finance')

This indicates that nature is often seen as a complex system not to be disturbed. Utilising a consequentialist style of reasoning couched in quasi-scientific terms, participants argue that GM is wrong because it disturbs the equilibrium of the natural world. Humans are frequently perceived to have behaved arrogantly in relation to nature, and GM is just another example of human arrogance for which humans ultimately have to pay a high price. Nature is seen as being able to take revenge, based on the perception that it has done so in the past already:

"Nature has worked millions of years to get things right and we're just messing things up in a moment! There is no respect for nature and I think it's very important that we have respect for nature. When we lose respect for nature, that's when things start to go wrong. Look at BSE, AIDS,..."

(female participant, 30, fg1 'country')

On the other hand, arguing from a deontological ethic, based on the notion that actions should or should not be carried out regardless of the consequences that follow, many participants consider "messing with nature" as simply ethically and morally wrong:

“It is not right. It is simply wrong to introduce genetic materials from different species, say fish or birds, into our foods. It is totally unnatural.”

(female participant, 54, fg3 ‘mature’)

Related to an ecocentric attitude towards nature, here actions are wrong because they disturb nature *per se*. Although few participants speak of playing God specifically, in many ways “nature” can be replaced with “God”, as already suggested by Wagner et al (2001).

Despite arguing from different perspectives, both themes are similar in that the basic point is that it is wrong to mess with nature. Caution is urged either in recognition of the danger of disturbing insufficiently understood natural equilibria or through an appeal to a sense of duty, of stewardship of nature. In both perspectives, human intervention would only destroy nature’s perfection, as in the words of Aristotle: *“nature does nothing uselessly”*. One of the reasons for this perception may be that GM has the potential to literally change our/nature’s essence. GM is frequently perceived as being an invasive technology touching the deep-seated essence of what makes us human:

“We shouldn’t rush into fundamental things like that too quickly. Once nature is changed, it’s changed forever”

(female participant, 31, fg1 ‘country’)

6.8.3 Acceptability and monstrosity

A particular aspect of ‘*messing with nature*’ is the perception that one should not ‘*mix genes*’. While some lay participants resist any kind of genetic transfer for the reason that it is “against nature”, others distinguish clearly between different levels of genetic transfer, finding some acceptable and others not. One participant sums up the majority opinion very well:

“What I came up with during this discussion is three categories, one is acceptable, the others are not. I just explain with this example. You have the salmon, first you can change the process of production, then you would get the effects of cheap salmon, but it’s still the same fish. I think

this is still acceptable. The second level is that you have this fish and you modify one gene so that it grows six times as fast as it would usually grow with the same food, and personally I would be very cautious about that and how we would regulate that. The third way of changing is crossing this fish with a bird or something, and this kind of exotic experiment we really don't need."

(male participant, 32, fg2 'law')

As the above quote shows, participants have boundaries of acceptability, often accepting same species transfer, but resisting genetic transfer between species. Effectively, there are levels of naturalness, and it is seemingly a taboo to cross species.

The perception that one should not "mix genes" is related to the idea that by "mixing species" something completely novel and unknown will appear:

"The problem is also that they put things together which would never have come together in nature, just creating something totally new scientifically."

(male participant, 30, fg5 'PhD')

In that way, it is a violation of natural kind boundaries which Wagner, Kronberger, Berg et al (2004) propose is strongly linked with the idea of monstrosity. Wagner et al suggest that monstrosity emerges when imagining the new transcends the boundaries of what is normal and natural and cannot be accommodated within the taken for granted order of the familiar world. The creation of a new kind of plant or animal may transcend hitherto known categories that structure the familiar world, thus putting the world as known at risk. There seems to be little awareness, that by for instance, inserting a fish-gene into a tomato, one would not necessarily create a 'tomato-fish'. Yet participants concerns are understandable. The (very memorable) hybrids presented in the media to date have indeed been a glowing mouse, glowing fish, or mice with a human ear growing on them, creating the link between "mixing genes" and monstrosity.

6.8.4 Natural versus unnatural foods

Moreover, the results indicate that the distinction between the natural and the unnatural may be especially pronounced in relation to food. For the purpose of comprehension, and because the issues often are not distinguished by lay participants, the code '*de-naturalised foods*'¹⁸ is used to describe comments about additives, chemicals, hormones, steroids, vaccines, antibiotics, colourings and preservatives. These concepts together make up the representation of "messaging with our food".

Although fundamentally different issues from a scientific perspective, for lay participants they all symbolise the unnaturalness and in many ways the unhealthy-ness of food. Many participants exhibit a kind of food anxiety whereby food in general is regarded as problematic and potentially harmful.

D: *"They can put chemicals in the genes to make tomatoes last longer. They are basically putting something in that just shouldn't be there. And we already have so many problems with chemicals in our foods, pesticides and all this stuff..."*

T: *"I think it's horrible what they do to our food today, did you hear they put horse and donkey meat into sausages? Disgusting! And people don't know about it because it's already processed, so they can't see what it really is"*

H: *"When you go to Greece or generally to the countryside it's different, the food there is still natural."*

(fg4 'finance')

Here, the polluted food (contaminated with something that "*just shouldn't be there*") is contrasted with the "*still natural*" food of the countryside, food how it was and how it ought to be. Calls for going back to how it used to be are common, which may explain the positive attitude towards organic farming. While GM and various intensive farming techniques are perceived as artificial, organic farming signifies the natural, and is hence perceived as a step in the right direction.

Thus there is a clear dichotomy between GM and organic food- something "foreign" as opposed to something known and trusted. In that way, does the separation of natu-

¹⁸ 'De-naturalised foods' is translated from the German 'denaturalisierte Lebensmittel', meaning any food that has been processed in some way, containing e.g. additives, colourings, or where the production methods diverge from traditional methods, such as chicken having been fed hormones, etc.

ral versus unnatural signify the separation of something familiar and something unfamiliar? If so, it would be interesting to know why GM is perceived as more foreign than other de-naturalised foods. Comparing GM to pesticides, participants answer this question as follows:

“Although pesticides may be bad for us, at least we know a fair bit about them by now, and also they are added to the food, aren't they, with GM on the other hand, you change the food itself, and I don't think that's right.”

(male participant, 32, fg2 'law')

So apart from the risks *per se*, GM is perceived as morally and ethically wrong. For many respondents, organic food is the solution to these problems. While GM is compared to intensive farming, traditional and organic farming practises, perceived to be more natural, are idealised.

This particular perception is summed up well by one of the experts:

“They see any new form of agricultural technology, whether it's GM, or battery hens, or pigs or feeding pigs antibiotics or whatever...they see it as an undesirable phase of agriculture. They would prefer it if agriculture was more, as the public sees it, more natural. As somebody who understands agriculture very well, I can say that there isn't very much natural about agriculture at all. But public perception is that it should be more natural, that animals should be treated in a more natural way, that crops should be grown in a more natural way, that maintain soil fertility and things like that.”

(Expert 7)

With regards to the above statement, it seems that while experts appreciate the public's concerns, they themselves rationalise it differently because they bring different representations into the issue. However, in many instances, lay participants also recognise that most food these days is not “natural” anymore as frequent comparisons to intensive farming show- hence they oppose GM as another step in the wrong direction.

6.8.5 The social significance of food

Furthermore, results indicate that lay participants' concern with food is also related to its social and cultural significance. This seemingly plays an important role in lay representations of GM food risk:

"I think GM is really unnatural and it's actually against of what we here think of as healthy food, do you know what I mean? In the US, they might not care much about it, they eat junk food all the time anyway which is completely unnatural and basically consists of chemicals, but here...we are still more traditional in our eating habits, we try to ensure that our foods are healthy, nutritional and naturally produced."

(female participant, 29, fg4 'finance')

Distinguishing themselves from the Americans, participants pride themselves on their cultural eating habits. In that way, food has a meaning beyond the food *per se*, with eating practises indicating a culture, lifestyle and identity, and healthy food implying that one cares about oneself and others. Moreover, the positive attitude to "healthy" organic farming is often also justified by caring for the environment, i.e. having an environmental consciousness, and caring for the world and future generations. In that way, organic food may appeal to a number of different positive values which are not shared by GM food.

This indicates that food risk may indeed be a special issue for risk perception and subsequently, risk communication. With or without GM- the food we eat and the ways in which it is produced is of major concern for lay participants. Thus it would be interesting to also investigate issues of naturalness and unnaturalness in relation to food *per se*, not necessarily priming for GM. This is one of the aims of the second part of our research.

To sum up the overall findings of the lay mental model, it is clear that lay participants have very different representations of GM food risks (and benefits) to expert participants. While benefits of GM are generally seen as negligible, lay participants perceive many risks, such as a wide variety of health risks. Although this may be connected to lack of knowledge in some respects, it is certainly exacerbated by the lack of trust in

science, government and industry- all perceived to have vested interests. In turn, this culture of suspicion, coupled with the perceived lack of adequate regulation, seems to make the scientific uncertainty inherent in most research, difficult to bear.

In addition, when assessing the risks of GM foods, in contrast to experts, lay participants include several value-related issues. Of particular importance here is the construct "*messing with nature*" which is one of the major lay arguments against GM. In this respect, the mental model approach clearly shows that many of the issues lay participants are concerned about are not addressed by experts. Indeed, it appears that many of the lay concerns cannot be effectively dealt with by this science-based approach alone. The following section elaborates on these expert-lay divergences highlighting the limitations of the CMU approach.

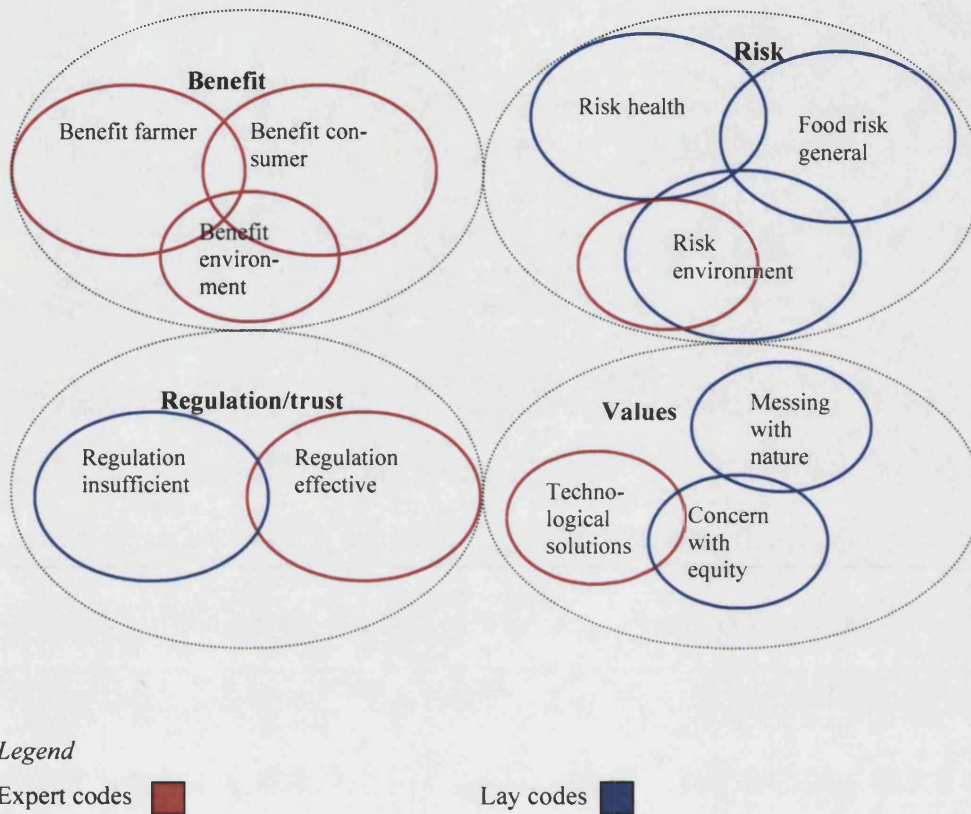
6.9 Comparing expert and lay mental models

To begin with, both expert and lay mental models of GM food risk are very complex, albeit on different issues. Regarding the purely scientific arguments as suggested by the CMU approach, expert participants have a more intricate representation of GM food risk. Yet when other non-technical factors are included in the representation, the lay mental model is more complex than that of the experts, with its various facets reflecting amongst others, Slovic's (1987) risk dimensions, such as whether the risk is involuntary, uncontrollable, unknown and invisible. These are essential parts of lay risk representations that cannot be adequately addressed by scientific expertise alone as proposed by the CMU approach.

As the discussion of expert and lay risk perceptions indicates, GM food risks are represented very differently by both groups. For the purpose of convenience and to draw a distinction between expert and lay perceptions, figure 6.3 shows a much simplified model of both groups' representations, comparing only their principal codes. It is striking that (with the exception of environmental risk) there are hardly any overlaps between expert and lay codings. Further, it is evident that there are several value-related topics that are not under the purview of science. In line with the CMU approach, the following section looks at the major differences between expert and lay

participants in detail before highlighting several cases where this science-based approach meets its limitations.

Figure 6.3 Comparison of expert and lay principle codes



6.9.1 Lack of factual knowledge

Although focus groups should be analysed as ‘one unit’, it is striking that there are many divergences in knowledge between participants within, rather than between groups. As the topic guide in Appendix B shows, participants were not asked questions about their factual knowledge in relation to GM, and despite variance between participants none had any specialised expert knowledge with regards to the topic under discussion.

Often, this lack of factual knowledge about GM could be relatively easy addressed in a risk communication- as long as recipients trust the communicator. In several instances, the focus groups reveal a need for further education in genetics as many par-

ticipants have insufficient knowledge that may heighten risk perceptions, particularly in relation to health risks:

“More and more people gain weight and become obese, and this is largely due to the genetic food. People don’t know what they eat anymore, how many calories it has and so it’s easy to put on weight when you eat GM.”

(female participant, 29, fg3 ‘mature’)

However, there are two levels to lay lack of knowledge- either participants are confident but factually incorrect (as above) or lack both knowledge and confidence:

“But how does it work? Does GM food grow normally as all other plants? I have no idea.”

(female participant, 31, fg2 ‘law’)

The perceived lack of knowledge extends beyond the actual science to the regulatory issues surrounding GM, as none of the participants seem to have knowledge about regulatory practises in the UK, whether in relation to GM or any other food. Most express a desire out find out more, yet find this difficult because:

“The problem is that a lot of these GM things are so scientific, so technical... for a layperson, he doesn’t have the skills to assess these situations.”

(male participant, 31, fg5 ‘PhD’)

In that way, as proposed by Michael (1996), when participants reflect on their own ignorance, they use it to delineate their own self- and group-identity in relation to expert knowledge and science, rather than as simply a deficit of factual information. Participants position themselves as lay people, with lack of time to acquire the expert knowledge on GM perceived as a necessary pre-requisite for decision making. For most participants there is little conscious involvement with the technology *per se*, and indeed, this they would happily leave to the experts- if only they could be trusted. The dilemma is that participants would prefer to trust and not to need to know as the topic

seems too difficult to understand but cannot trust, resulting in suspicion and confusion. Moreover, in the focus group situation, participants often treated the moderator (myself) as a proxy for science, with the moderator being seen as the generic scientist assumed to have expertise in relation to GM. For instance, I was often asked “*but what do you think?*”

None of the participants gave the impression of being satisfied with their state of knowledge, leading to frequent demands for more (generally meaning more balanced or clearer) information. Evidently, there are significant knowledge gaps in lay perceptions, that could be reasonably well addressed (and remedied) with a risk communication based on the mental model approach. Nevertheless, if trust is lacking, the effectiveness of any communication is questionable.

6.9.2 Risks

The perception of significant GM health risks (such as obesity and cancer) by lay participants is, in part, related to their lack of factual knowledge. Since experts tend to agree that the human health risks of GM are fairly small, it might be possible to alleviate these concerns with a risk communication based on the CMU approach.

However, in addition, lay participants are especially concerned about the long-term effects of GM, which science cannot accurately predict at the moment. For instance, a common argument by experts for the safety of GM foods is that millions of Americans have been eating GM since over a decade without ill effects. In contrast, lay participants do not think ten years is a sufficient “testing” time at all.

Moreover, where a risk communication is likely challenging is with regards to environmental risks, about which experts also disagree. As figure 6.3 shows, this is the area where expert and lay perceptions of the risk are already often matching. For example, in both groups there is concern about loss of biodiversity. However, environmental risks (and benefits) are shrouded in scientific uncertainty. Clearly, this area requires further clarification, between experts and the public, as well as between experts themselves. Hence certain areas of scientific uncertainty may need to be better

evaluated before an effective communication between experts and the public can take place.

6.9.3 Benefits

As figure 6.3 shows, expert and lay participants not only vary in their risk, but equally in their benefit perceptions. It seems that what counts as a benefit and what does not is a social (rather than scientific) judgement- which may be chosen in the same way that risks can be culturally chosen. While lacking detailed knowledge, lay participants are often aware of putative benefits of GM, for consumers as well as for farmers yet do not perceive those as actual “benefits”. Consumer benefits, such as “*better taste*”, are deemed unnecessary and unwanted. Benefits for farmers are vaguely appreciated, but it is preferred to stick with what is known, and not to proceed further down the route of intensive farming techniques. The promise of benefits for the third world is not trusted. Rather, in line with Expert 8, lay participants favour different ways of remedying global problems. Regarding environmental benefits, participants feel confused and express a desire to find out more.

Hence it is evident that “lack of knowledge” relates not only to risks that are perceived as greater by lay participants than by experts, but also to benefits as proposed by experts. In that way, the potential benefits of GM may also need to be addressed in a communication, as lay people are often keen to weigh up risks against benefits but do not feel able to do so due to lack of information.

6.9.4 Regulation and trust

While experts mostly regard the regulation of GM as effective, lay participants have neither trust in nor knowledge of regulation. Although not part of the scientific risk *per se*, the evident lack of trust in regulation is related to risk perceptions- if there is little trust (a substitute for knowledge according to Luhmann, 1979), risk is likely to be perceived as higher.

Yet it is unsurprising that the regulation of GM food is perceived as problematic by the public. It is an area of frequent expert disagreement whereby it is evident that a

range of regulatory issues still need to be resolved. The issues that need resolving (such as the validity of substantial equivalence) require value judgements- science alone seems to be unable to provide the answer. While lay participants are not aware of the intricacies of regulation, their lack of trust therein may nevertheless stem from the perception of (often publicised) expert disagreements. These expert disagreements also imply that, even within the scientific domain, there is not only one correct perception. Rather, it appears that risk assessments always involve some constructive elements. This further complicates risk communications as it raises the question of how to address these non-scientific risk dimensions. In that way, a GM food risk communication would need to go beyond the scientific facts *per se* as suggested by the CMU approach, and also include a number of non-scientific issues, such as those related to the regulation of the technology.

Especially in the area of regulation science cannot easily be divided from underlying societal values anymore (if indeed it ever can be). Lay participants criticise the lack of ethical framework currently in place and some experts also appreciate this concern:

“I think one of the interesting philosophical points about change, especially technological change, that it has always been incorporated into society before there were ethical frameworks to deal with the technology, to control the technology, and to regulate it. So the first time society sees a technology is in this chaotic way.”

(Expert 2)

6.9.5 The value dimension of GM food risk representations

Expert and lay divergences related to the scientific risk *per se* (such as those about health risks), and, to some extent, the regulation of GM foods could be addressed reasonably well in a risk communication according to the CMU approach. The CMU approach would set about to bring public perceptions and/or knowledge in line with the experts. Yet in relation to value-related issues this would be very difficult to achieve and it is exactly these areas whereby expert and lay participants differ significantly. Rather than simply arguing from different scientific premises, both groups also disagree on moral and ethical grounds. Hence the limitations of a purely science-based mental model approach are evident.

For instance, attitudes to scientific-technological progress are based on values rather than scientific knowledge *per se*. Experts generally favour scientific progress and technological solutions, such as utilising GM to remedy third world problems, viewing progress as an unambiguous societal benefit. While lay participants are not technophobic, it is continuously questioned how much progress is needed and beneficial- with most viewing GM technology as a step too far. There is considerable concern with equity- is it fair to the environment, future generations or the third world to introduce GM? Should we not look for '*deeper level solutions*' rather than pursue progress at potentially huge costs? Is it ever right to change nature in irreversible ways? Clearly, these types of questions cannot be answered through scientific rationality alone, meaning that the CMU approach based on the provision of scientific information is insufficient to effectively address lay concerns about GM food.

When comparing both mental models, it is clear that one value-related area not addressed at all by experts is the construct "*messing with nature*". But for lay participants, this is one of the major arguments against GM foods. When investigating the potential acceptability of GM, the present findings show that the genetic transfer between different kinds of species is definitely perceived to be "*messing with nature*" as it could not happen without human intervention. But results also open up further questions, such as what is behind the concept, what do lay participants really mean when they speak of messing with nature, and what images does this invoke? Likewise, what lies behind participants' veneration of "the natural"? Also, having shown that food risk *per se* is a particularly important risk category for lay participants in relation to GM, where do the boundaries of the natural versus the unnatural lie in relation to food? Answering these questions is the aim of our second research stage.

6.10 Conclusions Chapter Six

In conclusion, in agreement with the CMU approach, it is useful to find out what lay people do and do not know about a risk, what they want to know, and hence what knowledge can be build upon- both for the public desiring answers to their questions, and for the experts hoping to get their message understood. However, our findings indicate that the CMU approach alone cannot address all the issues lay participants are

concerned about. Being an essentially positivist approach, it aims to answer lay concerns with more and better scientific information which, in the case of GM food at least, is not sufficient as the real problems are not of a technical nature, but related to non-scientific issues, such as lack of trust and values.

Therefore, in practise, effective risk communication is likely to be much more challenging than implied by the CMU approach. Lay participants' suspicions about the motivations of actors involved in GM in various ways cannot be simply remedied with a scientific risk communication. And if trust is lacking any communication may be in vain.

The results show that the scientific risk *per se* is certainly not the only concern for lay participants. However, being based solely on scientific rationality and facts, the CMU approach neglects lay participants' social, moral and ethical concerns. Indeed it is questionable how these concerns (such as those about the ways in which nature should be treated) could be addressed in a risk communication at all. It appears that:

“As soon as questions of will or decision or reason or choice of action arise, human science is at a loss.”

(Noam Chomsky, 1978; p.126 *op cit*)

As such, science alone cannot be the only voice for making what are essentially moral and ethical decisions. Unfortunately, so far, values have not been sufficiently addressed in risk perception research, and ethical and moral issues are only beginning to be included in policy making. Yet in relation to GM food, values, and perceptions of what is natural or unnatural are a particularly differential aspect between expert and lay participants. As our results highlight the importance of these issues for lay risk representations they are explored in more detail in the second part of the thesis.

7 TOWARDS A SOCIAL CONCEPTION OF NATURE

The empirical findings of our first research stage established the importance of the construct “*messing with nature*” for lay participants’ representations of GM food risk. Thus it seems that risk perceptions of GM food are partly driven by notions of what is seen as unnatural about this new technology.

As indicated in Chapter One Sjoeborg’s (2000; 2002; 2003) studies also show the dimension “*tampering with nature*” to be a significant factor in explaining perceived risk. However, research has so far neglected to investigate this notion in depth. Hence we aim to provide a more detailed examination by looking at what lies behind this rather ambiguous construction. And to comprehend what “*messing with nature*” implies one has to first understand what “nature” means.

Thus the aim of the present chapter is to put nature into context. We make no claims to offer an exhaustive review of all the debates going on about “nature” in various scientific disciplines, rather we intend to provide a brief background to the ways psychology has attempted to understand the concept. In psychology, empirically the concept has been mainly addressed from environmental psychology which adheres to a strongly positivist and reductionist research ethic. Therefore, this perspective is of limited use for our risk perception research and hence only addressed in passing.

Recently the focus has shifted from individual perceptions of nature to the investigation of the related moral and ethical dimensions. This latter research area focusing on values seems to be a more promising research avenue in relation to risk perception, however, it can still be criticised for its individualistic orientation.

This individualistic orientation is problematic because it is evident that nature always incorporates a range of socio-cultural symbolisms. Hence we argue that there is a need for a more social psychology of nature in order to better understand the social construction of nature and naturalness. Unfortunately, empirically these topics have not been well examined, which is the aim of our second research stage.

7.1 Definitions of nature

“Nature is material and it is spiritual, it is given and made, pure and undefiled; nature is order and it is disorder, sublime and secular, dominated and victorious; it is a totality and a series of parts, woman and object, organism and machine. Nature is the gift of God and it is a product of its own evolution; it is a universal outside history and also the product of history, accidental and designed, wilderness and garden.”

(Smith, 1990; pp.1-2)

Acknowledging the partial construction of nature, Smith's (1990) definition indicates the challenges inherent in defining the concept. Broadly, there are three main concepts. Firstly, nature can mean the essence of something- as in *'it is in her nature'*. In this meaning, there is nothing unnatural in the world, because any phenomenon has its nature, its essence, or its meaning. The 'nature' of the natural sciences is based on this all-embracing concept of nature (Eichberg, 2000). Secondly, nature can mean the physical world in its entirety, perhaps including humans, i.e. nature as a universal realm of which humans as a species are a part (Dictionary of Human Geography, 2000).

Thirdly, nature can represent areas unaltered by human action, i.e. nature as a realm external to humanity and society (Eichberg, 2000). Eichberg proposes that the concept of nature represents an otherness, opposition, or liberation. For example, when saying *'going out to nature'* (to the green, outdoor environment), it is taken for granted that there is something, which is not nature. In romantic and idealistic terms, one can talk about going *'back to nature'* or as in our findings, *'back to our roots'*, and express by this phrase that something has become unnatural in the course of history. Nature in this way describes a contrast- taking distance from the present reality, where nature is absent and/or threatened (Eichberg, 2000). Here nature is not the whole, but rather a part, signifying a dichotomy of nature and un-nature (Eichberg, 2000). It describes an otherness in confrontation with the artificial or the urban, with civilisation, or industrial life. This is often seen in psychological research where the *'natural environment'* is contrasted with the *'build environment'* (e.g. Kaplan, Kaplan and Wendt, 1972; Kaplan, 1984). 'Nature' functions thus as concept of opposition, resistance, or liberation, creating a counter-world (Eichberg, 2000).

7.1.1 Nature, environment and wilderness

So far, psychology has been mainly concerned with the environment, yet neglected nature. While the environment is generally conceived in material, spatial and social terms, nature seems to have broader and more affective connotations, leading Kroemker (2004) to conclude that environment is a specific variant of nature, but not the whole picture. What distinguishes nature and environment is unclear, boundaries are ambiguous, and definitions vary. However, one of the main distinguishing factors is the role of man- nature is untouched by man, while environment is related to the man-made components (Kroemker, 2004).

Similarly, Kaplan et al (1972) equate natural environments with environments that have no evidence of human intrusion, defining them through contrast with build environments, considered the antithesis of naturalness. In other words, nature is non-artificial, and environment is no longer nature in this respect (Graumann and Kruse, 1990). In contrast, Kaplan (1977) does not distinguish categories of natural elements from categories of environments. Trees are cited as examples of everyday nature, together with roadside views and backyard settings. Nevertheless overall, human impact seems to be the primary, albeit not the sole, dimension of naturalness.

Reflecting a US bias in research, many studies on natural environments have focused on wilderness (e.g. Kaplan and Talbot, 1983; Kaplan, 1984). The tendency to dichotomise natural and urban environments may stem from this conceptualisation of nature as wilderness. Nash (1982) proposes that although the word wilderness is noun, it acts like an adjective. As the -ness suffix suggests, the term designates a quality that produces a certain mood or feeling. In this case, wilderness is both a physical condition and a state of mind (Scoyen, 1969). Accordingly it makes sense that the present study should concern itself not only with nature, but equally, naturalness.

The ambiguity of these concepts may be because a definition has rarely been explicated. Social scientists have assumed that sufficient agreement exists to guide any research adequately (Mausner, 1996). With few exceptions (e.g. Mausner, 1996), researchers rely on their own concepts of nature, implicitly assuming that their subjects share the same definition. Therefore it is critical that research also addresses nature

and naturalness as defined by participants, which we aim to establish through the free association task.

7.2 Empirical research on nature

Like risk, nature has an essentially positivist research tradition. Until the late 1980s the vast majority of psychological research into nature has been concerned with aesthetic preference and pleasantness, followed by studies of emotional and physiological impacts of outdoor scenes in the 1990s. These research areas are of limited relevance for the present study and are thus discussed only briefly.

In the late 1990s research began to incorporate the moral and ethical dimensions of nature, and to address the significance of environmental values. These studies are discussed in more depth due to their potential significance for risk perception and, subsequently risk communication.

However, all the above approaches can be criticised for their individualistic orientation, which leads us into why we propose a more constructivist perspective for the purposes of the present study.

7.2.1 Environmental psychology

Environmental psychology (e.g. Altman, 1975; Altman and Wohlwill, 1983; Stokols, 1976) focuses on intrapersonal processes, such as perception and cognition that mediate the impact of the environment on the individual. The emphasis is on the manner in which psychological and social processes interact with features of the physical environment to yield patterns of behaviour.

Research in environmental psychology generally stresses psychological, physical and social determinants of behaviour and is conducted primarily at the micro level of analysis (Stokols, 1977). There are three main strands of research: the environmental preference literature, the psychological effects of nature literature, and most recent, research addressing environmental values.

In brief, landscape preference research predominantly addresses the question of which characteristics a landscape or natural environment should possess to be preferred. Studies are not explicitly about the relationship of man and nature; rather the focus is on how a natural space is structured from a psychological perspective.

Generally, landscapes perceived as natural, i.e. without any notable human influences/interventions, are preferred (Kaplan and Kaplan, 1989; Mausner, 1996), and the (suggested) presence of human influences in natural scenes usually has negative effects on preferences of these scenes (e.g. Zube, 1973; Zube, Brush and Fabos, 1975). Often, assessment of naturalness diminishes in direct relation to perceived increases in human impact. The broader the scope of a human intervention, the more likely it is to negatively influence perceived naturalness (Mausner, 1996). Consequently, due to its potentially huge impact, it is unsurprising that GM is often perceived to be 'unnatural'.

But while the environmental preference literature can help to establish what characterises 'nature', 'wilderness' and 'landscape', it does not ascertain what it actually all means for humans. Acknowledging the importance of the constructivist element in landscape, Tuan (1979) writes:

"Landscape ... is not to be defined by itemising its parts. The parts are subsidiary clues to an integrated image. Landscape is such an image, a construct of the mind and of feeling."

(Tuan, 1979; p.89)

This implies that positive responses to nature extend far beyond the domain of aesthetics. A growing body of research suggests that natural scenes possess physiological and psychological restorative powers (e.g. Altman and Wohlwill, 1983; Francis and Hester, 1990; Kaplan et al, 1989; Relf, 1992). In brief, natural scenes have been clearly shown to have positive effects on subjects' emotional states (e.g. Ulrich, 1979; 1981). The experience of 'being in nature' has been found to be a source of spiritual inspiration (Fredrickson and Anderson, 1999) and appears to integrate physical, emo-

tional, cognitive and spiritual components, for instance relaxation, safety from other people, and freedom from social responsibilities and constraints.

7.2.2 Limitations of environmental psychology

Despite their divergent research aims, these different strands of environmental psychology share a major limitation. All are still rooted in the work of traditional positivist psychology borrowing its reductionist models- neglecting social, cultural, and historical contexts. Hence the above approaches can be criticised for being individualistic. They generally fail to theorise or investigate the social, political, or cultural dimensions, which structure the material world itself. Symbolic realities are left outside the scope of analysis, which as the second section of the present chapter shows, is problematic for the study of nature. By looking at nature from a more constructivist perspective, we demonstrate below that nature always has important symbolic elements that are neglected by positivist approaches.

In that way, positivist approaches do not provide a suitable framework for understanding the environment as a social construct and the symbolic and material practises of people in relation to it (Gervais, 1997). Relying heavily upon numerical scales to express individual preferences (e.g. Kaplan et al, 1989; Zube, 1973) interpretations of human-environment interactions are often too simplistic. Also, subjects' responses are generally assessed according to scales made by researchers beforehand, meaning that participants rarely use their own concepts when speaking about nature (e.g. Ohta, 2001). Furthermore, as shown above, in most studies, the environment is conceived either in terms of its relation to the (bio-physical) needs of the individual, or in terms of its importance for the regulation of social interactions. Studies largely focus on the functional and visual components of settings, often describing places merely in terms of their physical location and appearance.

Yet what about the social and societal aspects of nature? How do humans perceive their relationship to nature today? What place does nature take in society? What do people really mean when they speak of nature or '*messing with nature*'? Clearly, there is a need to re-investigate the relationship between humans and nature as such questions have not been addressed by environmental psychology. Even Kaplan and Kaplan

(1989; p.1), two major scholars of environmental psychology, admit that traditional scientific methods may be insufficient as “*it is hard to justify the role that nature plays in rational terms*”.

Moving away from positivist environmental psychology, some more promising research areas include the new environmental/ecological paradigm (NEP), and research focusing on values related to nature.

7.2.3 The new environmental and new ecological paradigms

The new environmental paradigm (NEP; Dunlap and Van Liere, 1978) has been the most prominent measure of environmental attitudes during past 20 years, and presented the first attempt to incorporate values in environmental research. Rather than measuring specific attitudes, Dunlap et al (1978; 2000) developed a series of items to assess people’s “ecological worldview”. Focusing on the environmental movement of the 1970s, they noted that there was more than just attitudes and concerns about environmental issues- implicit in environmentalism was a challenge to society’s fundamental views about nature and humans’ relationship to it. Hence, the NEP focuses on beliefs about humanity’s ability to upset the balance of nature, the existence of limits to growth for human societies, and humanity’s right to rule over the rest of nature. The New Ecological Paradigm (Dunlap, Van Liere, Mertig and Jones, 2000) is the revised NEP scale which beyond these original three facets to also include beliefs about ‘human exemptionalism’, i.e. the idea that humans- unlike other species- are exempt from the constraints of nature.

Overall, both paradigms were designed to measure the degree to which people view humans as part of nature, rather than as consumers or protectors of nature (Dunlap et al, 2000). Findings show that a person’s environmental paradigm seems to constitute a fundamental part of a person’s belief system; it is a primitive belief¹⁹ and influences a wide range of concerns and attitudes concerning more specific environmental issues (Dunlap et al, 1978; 2000).

¹⁹ Primitive beliefs form the inner core of a person’s belief system and “*represent his ‘basic truths’ about physical reality, social reality and the nature of the self*” (Rokeach, 1968, p.6).

However, there is still ambiguity in measuring these phenomena. While the NEP aims to focus on broader social issues, moving away from individualistic psychology, it is limited in that it measures general environmental concern. Moreover, the approach lacks a clear theoretical foundation of why a person develops the types of attitudes s/he does (Schultz, Shriver, Tabanico and Khazian, 2004). Hence since the middle of the 1990s, new research approaches began asking fundamentally different questions investigating environmental attitudes in more depth, specifically addressing the underlying values of such attitudes.

7.3 The value basis for environmental concern

Recently, a more detailed literature on the ethical and moral dimensions of environmental concern has been emerging. Research has shown that a high percentage of people worldwide know about and are concerned about environmental problems (e.g. Dunlap, 1991; Dunlap et al, 2000; Ray and Anderson, 2000). The recognition that human activities are altering the ecosystem has led to a growing acknowledgement of the necessity of more sustainable forms of development. This has led to the suggestion that society is in the midst of a fundamental re-evaluation of the underlying worldview that has guided humans' relationship to the environment (e.g. Milbrath, 1984; Inglehart, 1990²⁰).

In the literature, the terms concerns, values and worldview are often used interchangeably. Schultz et al (2004) suggest the following distinction. First, environmental concerns refer to the affect (i.e. worry) associated with environmental problems. Second, attitude describes a person's evaluative judgement about a particular entity, typically expressed in degrees of favourability (Eagly and Chaiken, 1993), while environmental attitudes consist of a collection of beliefs, affect and behavioural intentions regarding environmental issues. Social psychological research on values suggests that attitudes are often associated with multiple, even contradictory, values (Eagly et al, 1993). Third, worldviews concern a person's beliefs about humanity's

²⁰ In brief, Inglehart (1990) argues that environmental concern is part of the shift towards post-materialist values in western societies, developing among wealthy people once the more basic needs of food and safety have been met.

relationship with nature (Schultz et al, 2004). Fourth, at the broadest level are values, which are conceptualised as important life goals or principles (Rokeach, 1973). Values function as organising system for attitudes and beliefs, and are viewed as determinants of attitudes (Schwartz, 1994). Environmental values refer to those values that are specifically related to nature or that correlate with specific environmental attitudes or concerns (Schultz et al, 2004). Essentially, all definitions suggest a value-basis for environmental concern.

7.3.1 Environmental ethics

Particularly in light of the environmental crises facing society today, such as global warming, how man's relationship with nature is perceived is likely to influence the solutions to these problems. Is nature regarded as property of man, to be used however desired or does nature have intrinsic value, value aside from its usefulness to humans?

Thus traditional measures of environmental concern are being supplemented by instruments seeking to measure 'ecological consciousness' (Ellis and Thompson, 1997), anthropocentrism (Chandler and Dreger, 1993) and anthropocentrism vs. ecocentrism (Thompson and Barton, 1994). Such research explicitly attempts to identify the underlying values that provide the basis for environmental attitudes. Hence, two people could be equally concerned about environmental issues but for fundamentally different reasons (Schultz and Zelezny, 1999). Anthropocentrism and ecocentrism are two ways of understanding an extension of ethics to nature, i.e. when and why humans extend their ethical scope to include nature.

Anthropocentrism represents the idea that humans are the centre of the universe (Campbell, 1983). It considers humans to be the most important life form, and other life forms only important to the extent in that they affect humans or can be useful to humans. Here, nature deserves moral consideration because harming nature can harm humans (Kortenkamp and Moore, 2001).

Ecocentrism represents the idea that the universe is the originator of life (Campbell, 1983). Adopted in the 1970s by deep ecologists (e.g. Naess, 1988), it refers to the idea

that all life has intrinsic value, and hence deserves moral consideration (Kortenkamp et al, 2001).

In sum, in an anthropocentric ethic nature deserves moral consideration because how nature is treated affects humans. In an ecocentric ethic nature deserves moral consideration because nature has intrinsic value (Kortenkamp et al, 2001).

7.3.2 Value-based environmental research

Utilising related values dimensions to above, the value-belief-norm model (Stern and Dietz, 1994; Stern, Dietz and Guagnano, 1995) aims to explain environmental attitudes and behaviours, stating that a person's environmental attitudes are the result of a more general set of values. The model postulates a causal chain of variables that leads to behaviour: values, worldview, awareness of adverse consequences for valued objects (risk perception), perceived ability to reduce the threat, and personal norms for pro-environmental behaviour. It predicts that individual values interact with specific perceptions of a given situation to yield behaviour.

Specifically, there are three different bases for environmental attitudes: the individual, all people, and all living things²¹. Egoistic values focus on the self and self-oriented goals (for example, social power or wealth) based on beliefs about the effect that environmental destruction may have on the individual (Stern et al, 1994).

Taking a broader perspective, altruistic (or social-altruistic) values focus on other people (for instance, family, community or humanity), and are concerned with human benefits or human goals. Here, protecting the environment is considered important because of the long-term consequences on others; environmental issues are judged on costs and benefits to all people.

Lastly, adopting concern for the whole biosphere, biospheric values focus on the well-being of all living things (plants, animals, trees) and hence centre on the inherent value of nature. Here, humans should not harm nature because they are part of nature.

²¹ A very similar tripartite classification is proposed by Merchant (1992) who terms the dimensions egocentric, anthropocentric, and ecocentric.

These terms are also used in Schultz's (2001) value-basis theory. This theory is an extension of Schwartz's (1977) norm-activation model of altruism, suggesting that environmental concerns are due to an awareness of harmful consequences (i.e. risk) to a particular value or valued object. Different value orientations lead to different attitudes; and the link between values and environmental concern is moderated by risk perception. The theory proposes that attitudes are formed by considering a few salient aspects of an attitude object and the relevance of this object to a few salient values. Environmental concerns and behaviours are viewed as the result of an activated altruistic moral norm, although attitudes clearly can be linked to a broader range of values, not just altruism (Schultz, 2001).

There is considerable evidence for the existence of value-based environmental concerns (e.g. Thompson and Barton, 1994; Schultz, 2000; Stern et al, 1995). Findings generally indicate that egoistic and biospheric concerns are related to different values. For example, egoistic concerns are positively correlated with self-enhancement²² and negatively with self-transcendence while biospheric concerns are negatively correlated with self-enhancement, and positively correlated with self-transcendence²³ (e.g. Schultz, 2001; Schultz and Zelezny, 1999).

These values are perceived as a continuum- at one extreme is the individual who believes s/he is separate from nature, and that humans are exempt from the laws of nature and superior to plants and animals. At the other end is the individual who believes that s/he is as much part of nature as are other animals, and that the same rights should apply to all. This core belief is 'connectedness with nature' (Schultz et al, 2004). Results thus far suggest that the type of concerns an individual develops is based on the degree to which they perceive an interconnection between themselves and others (altruistic) or between themselves and nature (biospheric) (Schultz, 2001).

²² Self-enhancement reflects the degree to which a person values goals and ideals that are directly linked with tangible rewards for the self, e.g. successful, wealth, social power. This orientation towards self benefit; people who score high on this measure do not define other people or other living things within their boundary of self (Schultz, 2001).

²³ Self-transcendence reflects the degree to which a person values goals and ideals that are not directly linked to the self, e.g. a world of beauty, honest, loyal, and also the degree to which a person includes other people and living things within their boundary of self (Schultz, 2001).

7.3.3 Limitations of value-based environmental research

Although value-based environmental research offers a new direction for psychological research into the relationship of man and nature, it is still limited in several ways.

First, despite their obvious relevance to environmental concerns, few empirical studies have addressed the concepts of ecocentrism and anthropocentrism in depth, and there still exists the problem of 'measuring' distinctions between both ethics (Kortenkamp et al, 2001). Overall, no consistent model or theory for understanding environmental values, motives, and behaviours exists, as research tends to be fragmented and difficult to integrate into organised theory.

Second, above approaches are limited in that they are still founded on traditional (individualistic) attitude theory. This means that values and 'connectedness with nature' have generally been construed as individual psychological variables, rather than as socio-cultural concepts. Yet values are social and societal rather than individual constructs, indicating that a more social psychological approach to nature may be more appropriate than research that is essentially still based on the positivist paradigm.

Hence there is a need for a more constructivist approach to nature because to date, the social dimensions of nature are significantly under-examined (Macnaghten et al, 1998). The silence that surrounds the concept of nature within the social sciences has been repeatedly criticised (e.g. Katz and Kirby, 1991; Fisher, 2003), and it is still unclear how the relationship of humans and nature is defined and what the concept of nature incorporates as it has rarely been addressed in sufficient depth. But it is important to further investigate the concept empirically since:

"Are humans an integral part of nature or are they separate from it and in some way superior to it? The answer to this question is crucial in determining how different thinkers and religions decide which human actions can be regarded as legitimate or morally justified. From this flow other related questions about whether all plants and animals in the world are there solely for the benefit of human; about whether humans have a responsibility to guard and take care of the rest of nature."

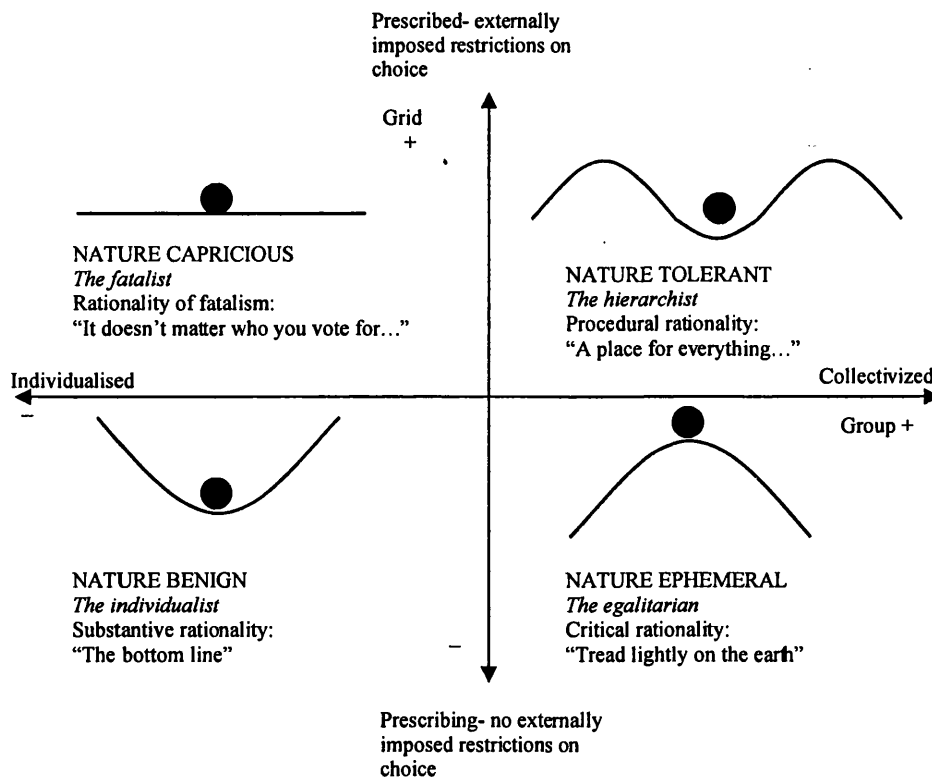
(Ponting, 1991; p.141)

7.4 Cultural theory and myths of nature

The above sentiments are appreciated by Schwarz and Thompson (1990). Providing a constructivist approach to nature, Schwarz et al (1990) extend the grid-group analogy of cultural theory as outlined in Chapter One into the realm of environmental understanding and social practises, arguing that credibility of any view of how the environment will react to human activities is secured by the moral commitment of a community to a particular set of social/institutional regimes.

Schwarz et al (1990) identify four idealised conceptions of how nature responds to human activities. Using the analogy of the movement of a ball in a landscape to show the relations between human activity and the natural world, they identify four primary myths of nature, which map into the grid-group typology. Figure 3.1 shows how the myths of nature can be mapped onto the rationalities of cultural theory.

Figure 7.1 *The myths of nature mapped onto the rationalities of cultural theory* (from Schwarz and Thompson; p.9).



Each myth functions as cultural filter so that adherents are predisposed to learn different things about the environment and to construct different knowledges of it, and each of these views appears “irrational” from the perspective of any other.

According to this typology, the fatalists view nature as capricious, suggesting an inherent unpredictability to the ways in which nature responds to human activities. This perspective stresses the essential randomness and lack of control of natural events and outcomes, and favours a pragmatic view of nature and its behaviour (Schwarz et al, 1990).

Supported by hierarchists is the representation of nature as tolerant/perverse. Here nature is perceived as forgiving in most instances but is vulnerable to an occasional ‘knocking of the ball over the rim’. Hence both nature’s vulnerability and its resilience are recognised. Thus the importance of regulation against unusual occurrences is emphasised. This myth reflects scientists’ views of the world in which expert knowledge is prioritised. Nature’s balance is perceived to be determined by natural limits and laws which human activities may either observe or exceed and the role of the expert is to provide advice to society so that these limits are not abused (Schwarz et al, 1990).

The individualists view nature as benign. Here nature is represented as being capable of recovering quickly from exploitation by humans. Nature is seen as forgiving, no matter what knocks are delivered, the ball will return to the bottom of the basin. This view is similar to the egocentric beliefs identified by Pepper (1984). Adherents of this view rely on technocratic and managerial approaches for speeding up or assisting nature’s recovery (Schwarz et al, 1990).

Lastly, associated with the egalitarian way of life (and often representing counter-cultures in modern societies, such as the German greens) is the view of nature ephemeral. Offering a contrast to nature benign, this view emphasises the vulnerability of natural systems so that any human activity involving nature is regarded as potentially damaging to the integrity of natural systems. Linked with an ecocentric worldview, views are consistent with advocacy of the precautionary principle (Schwarz et al, 1990).

Unfortunately, as with cultural theory in general, empirical support for these typologies is lacking thus far²⁴. Also, Kroemker (2004) argues that these typologies are oversimplified because they neglect the possible nuances within them. It is unclear whether these are individual types or part of a continuum, i.e. from nature ephemeral to nature benign? Research to date is inconclusive, and it is likely that typologies are far more complex than cultural theory suggests (Kroemker, 2004). Thus essentially, it can be argued that from a social psychological perspective at least, nature has not yet been well researched empirically.

7.5 Social conceptions of nature

Today, proposals to re-introduce the concept of nature into the social sciences are made more and more frequently (e.g. Grundmann and Stehr, 2000). It is increasingly appreciated that it is essential to move beyond the individual to the social and symbolic dimensions of nature to fully capture the concept, to find out what nature represents, and what it *means* to people. Therefore, we take a more social perspective looking at how nature has been represented historically and culturally to show how societal developments have influenced (and continue to influence) different representations of nature.

7.5.1 Socio-cultural symbolisms of nature

A seminal work in the German literature is Oldenmeyer's (1983) typology of nature representations²⁵. Oldenmeyer's typology can be either understood from a historical

²⁴ Kempton, Boster and Hartley's (1995) study on environmental values indicates how cultural models are ingrained in American society and how they provide the basic conceptual underpinning of lay thinking about the environment. It can be argued that their three cultural models of nature are in some ways similar to Schwarz et al's (1990) types. For instance, Kempton et al's model of nature as fragile and limited corresponds to the egalitarian way of life, while their model characterised by the current American way of living, industrialism and consumerism corresponds with the individualists' viewpoint. However, the present thesis does not discuss this work in detail as it still adheres to an individualistic perspective, defining cultural models simply as mental models that are shared. As such, culture is perceived as residing in the individual, and as separate to the external reality defined by science (Macnagthen et al, 1998).

²⁵ Oldenmeyer (1983) speaks of 'Naturbildern'. Literally, these are pictures of nature, but are translated here as nature representations, a more fitting translation in the present context.

perspective as a form of progress (from pre-industrial to post-modern times) or equally, as various types that co-exist.

Firstly, during pre-industrial times, nature was represented in a (mostly religious) magical-mythical way. Man and nature were in a symbiotic relationship- nature was seen as a partner that had to be respected in order to avoid punishment. In pre-industrial societies, there was little choice but to work with and use nature. From today's perspective, nature and humans were very close- there were few technologies that offered the opportunity to separate man from nature and allow abuse of a great scale. The prevalent perception was that anything that was different from 'nature' could not be desired from God, and that bad things happened as nature's response to human actions (Oldenmeyer, 1983). Such a respectful and caring relationship of man and nature can still be found in for example Native American Indian cultures²⁶.

Secondly, a holistic representation of nature incorporates the perception that man and nature are "one". Here, nature and man are not separate entities, in that way, what one does to nature, one does to oneself (Oldenmeyer, 1983). The perception that one needs to listen to nature and disturb her as least as possible is still represented in Buddhism and Taoism.

However, advanced industrial societies progressively moved away from these representations. Today, nature is decreasingly seen as godly power and it appears as if there is an increasing separation of man and nature. Often these developments are attributed to the decline of religion and the continuous and rapid advance of science in western societies (Oldenmeyer, 1983).

7.5.2 Science and nature representations

Regarding the advance of science in the past centuries, Descartes' philosophy is attributed a particular influence on these developments, as humans and human consciousness were perceived as being 'above nature', while simultaneously theological

²⁶ For example, in some constructs of the Native American life world no dualities between humans and nature, or necessarily between animate and inanimate objects, exist.

perspectives on nature decreased. Humans were given priority over nature, culminating in the view of man being the only measure of all things in nature.

This technological-utilitarian use of nature went hand in hand with the industrial revolution, which reduced man's direct contact with nature. At the same time, science and technology were confidently perceived to be able to bring solutions to most human problems. Moreover, 19th century science, especially evolutionary theory, has played a fundamental role in shaping our understandings of nature (Williams, 1981). Consequently, since that time the dominant discourse of nature was that of science, rather than religion (Pepper, 1984). Science became the paradigm of reason, including moral reason (Wagner, Kronberger, Gaskell et al, 2001).

Katz and Kirby (1991) suggest that the model of natural rationality has insinuated itself into modern lives, withdrawing humans from a comprehension of nature within everyday life. Hence today, as already established in the context of risk the world as constructed by the natural sciences is the dominant paradigm:

“Greek philosophers, mathematicians and medical men committed their scientific successors exclusively to this effective direction of thinking. They closed for Western scientific thinking the elsewhere open questions of what kind of world people found themselves inhabiting and so of what methods they should use to explore and explain and control it”

(Crombie, 1988, p.1)

However, our findings in the previous chapter indicate that rather than the science *per se*, in relation to GM food at least, the question of what world people want to live in and how nature should be treated is of major importance. In many ways, science is no longer perceived as being able to establish moral principles by reasoned debate alone, or to provide safe predictions of events as in the past (Wagner et al, 2001). For example, our results show that the risks of GM food are publicly often perceived as being unknown and unknowable within current scientific knowledge, and that, in agreement with Wagner et al (2001) nature itself is frequently viewed as a complex system, where prediction and control are beyond human capabilities.

In sum, these divergent perceptions of nature indicate that nature is far more than a material given, but rather that representations are constructed through social and historical developments. Hence nature representations are socio-cultural and fluid rather than individual and stable phenomenon as implied by environmental psychology. Although the positivist perspective holds that nature is not "*a mere cultural convention or artefact, as some postmodernists maintain, but part of a physical and biological reality that bounds children's cognition*" (Kahn, 1999, p.7), this does not necessarily deny the symbolic dimension of nature. Clearly, the societal relationship to nature has some material dimensions, as well as always consisting of important symbolic aspects (Jahn and Wehling, 1998). And to investigate these symbolic aspects in more depth, there is a need to move away from the prevalent positivist to more constructivist perspectives on nature.

7.5.3 A constructivist perspective on nature

Macnaghten and Urry (1998) postulate that rather than a single nature, there is a diversity of contested natures, constituted through a variety of socio-cultural processes from which they cannot be plausibly separated. As shown above, specific social practices produce and transform different natures. Because nature is not only a physical entity, it is important to recognise how nature is structured and shaped through social, cultural, scientific and political processes. Nevertheless, to date, empirical research that could account for the different facets and meanings of nature is still rare. Social representations theory (SRT) as discussed in relation to risk in Chapter Three may provide a useful alternative to the predominantly positivistic orientated approaches.

Arguing that nature always has a *human* history, Moscovici (1976) strongly rejects the dualism of man and nature, proposing that both the assumed non-historicity of nature and the separation of nature from humanity are simply (in-) convenient fictions. In that way, the strict dichotomy between some reified nature untouched by human practice and a culture divorced from it is not warranted.

Briefly, Moscovici argues that humans have continuously changed throughout their history. Likewise, nature as a permanent given is inaccessible; instead, there is a succession of natures. From the moment humans begin to act upon material forces, they

also create themselves, i.e. their historically and spatially located *states* of nature. Particular natural configurations include humankind as an internal, creative, organising factor, thus humans cannot be deduced from some autonomous natural process. Hence Moscovici proposes to relinquish conceptualisations of nature and society which present these two terms as either unrelated or opposing spheres. All human practises, by virtue of being human, belong to the realm of nature. Likewise, any natural configuration is in part a human creation- nature is always at least partly constructed (Moscovici, 1977). In this sense, invention does not create some artificial anti-nature- on the contrary it is the accomplishment of humankind's own nature (Moscovici, 1977). In the words of Gervais (1997):

"The human history of nature is the history of the social construction of states of nature through the activities of members of natural categories who, by their labour, effect changes both in matter and in themselves."

(Gervais, 1997; p.76)

In essence, nature contains vast amounts of human history, with the current understanding of nature resulting from a complicated array of ideas, linked to e.g. culture, religion and science. Regarding nature as a social representation shows how nature is constructed, in that all natures are geographically, historically and socially constituted. Thus ideas of nature are always intertwined with ideas of society at a particular time²⁷ (Macnaghten et al, 1998). Lukacs (1923) proposed a long time ago that

"Nature is a societal category. That is to say, whatever is held to be natural at any given stage of societal development, however this nature is related to man and whatever form his involvement with it takes, i.e. nature's form, its content, its range and its objectivity are all socially conditioned."

(Lukacs, 1923; p.234)

²⁷ Macnaghten et al (1998) suggests that if nature is indeed socially and culturally constructed (and hence likely contested), it cannot readily provide society with the foundations for the correct moral and ethical life. On the other hand, representations of nature may still provide people with a context in which to understand the uncertainties and risks of post-modernity because "*cultures of nature may on occasions facilitate the kind of communities or traditions that provide an enormously significant sense of meaning and value in societies struggling to break from the modern world*" (Macnaghten et al, 1998; p.4).

7.5.4 The social construction of naturalness

Thus it appears that nature as known and encountered today is largely a socio-cultural construct, as it has been transformed physically and appropriated culturally. Nature is rarely “really natural”- there is almost always some human and social intervention (Eichberg, 2000). For example, the dichotomy between what is natural and unnatural is artificial as human involvement, such as the planting of trees, has long been part of “nature” (Clayton and Opatow, 2003). Similarly, writing about “the end of nature”, suggesting that there is no more nature in the traditional sense, McKibben (1989; p.58) states that *“by changing the weather, we make every spot on earth man-made and artificial”*.

This raises the question of where the perceived boundaries of nature versus non-nature might lie. Evidently, these boundaries are neither clear-cut nor necessarily a reflection of scientific assessments.

Herzlich (1973) shows how even scientific assessments of physical assessments of states of the body are partly socially constructed. Her findings indicate that health and illness are neither always clearly defined nor unambiguous entities. Rather, the results reveal the notions, categories and kinds of language through which both health and illness are socially constructed. In that sense, it is shown that judgements about health are not straightforward assessments of one’s physiological state. Instead they are the result of evaluations of complex relations between individuals, society and nature. For example, Herzlich’s interviewees state that good health results from harmonious relations between self and nature and that living in the countryside is healthy, whereas illness results from the “unnaturalness” of city life such as air pollution and noise.

Exposing the fallacy of the dichotomy of “the natural” versus “the social”, Herzlich proposes that so-called natural objects inevitably become social from the moment they begin to signify something for human beings. In line with SRT it is evident that representations of an object arise in a social context, through social communication and interaction (Gervais, 1997). In this sense, the boundaries between man and nature do not correspond to some fixed reality but rather are social products.

In light of this, a constructivist approach (such as SRT) provides a useful challenge to the dichotomy between nature and society, illuminating the existential meanings, for social subjects, of particular representations of nature. In turn, this may elucidate not only where, but also why boundaries of naturalness are constructed the way they are. Since these are social and societal judgements these questions cannot be answered by positivist science alone. Indeed, Gervais (1997) argues that the social values which nature embodies and symbolises are probably far more important in structuring such representations than any physical attributes.

As representations of nature can be understood as socio-cultural patterns they need to be seen in their social, cultural and historical contexts. Hence building on Moscovici's (1977) approach, Gervais proposes that there is a need for a more social and societal approach to nature because:

"A social psychology of nature can only succeed in constituting itself as a science if it ceases to endorse a naturalistic view, that is if it views nature as being constituted symbolically rather than merely given."

(Gervais, 1997; p.65)

7.5.5 The need for a social psychological approach to nature

Since the advent of the environmental movement in the late 1960s environmental issues have become more and more prominent in policy, as the environment and nature have been increasingly perceived as threatened by the by-products of industrialisation. Lately, it has been suggested that the development in western societies of a 'green consciousness' reflects one self-conscious strategy to combat the alienation between man and nature (Katz et al, 1991). This movement was an important factor in the social construction of the environment, leading to changes in society's ecological awareness (Graumann et al, 1990), by providing a technological and progress-critique, which crystallised in relation to nuclear power and later biotechnology (Kroemker, 2004). Since such concerns are societal problems, a more social psychological approach to nature is needed. Moreover, as nature and environment are (partly) social constructions the attributed meanings require investigation (Graumann et al, 1990).

Yet, like risk discourse in general, environmental discourse is a fairly recent phenomenon. Risks to nature are not new, for example, floods are as old as humankind, and even in the Middle Ages protection measures for water and air were put into place (Schneidmueller, 1989). However, as discussed earlier, in each era, nature has a particular symbolism in society. The prevalence of a risk discourse in relation to nature today can be largely explained through the move away from religious towards scientific discourse. Science enlightened the essence of these problems (Graumann et al, 1990), and as shown in Chapter One, scientists' role in creating as well as solving them.

Just as other risks are also culturally constructed (Douglas et al, 1982), the environment has a strong socio-cultural constructive dimension, as societies differ in their social representations of environmental risks. For instance, Waldsterben (i.e. "dying forest") in Germany does not "exist" in France (Graumann et al, 1990). Graumann et al suggest that this may reflect a romantic bond with the German forest. Moreover, the popularity of the "Waldsterben" discourse may also be attributed to the relative prevalence and visibility of the German greens since the 1980s. This group likely played a significant role in changing Germany's representations of nature by actively cultivating images of and communication about dying forests, acid rains and environmental destruction more generally. This indicates how environmental problems can be historically, socio-culturally and politically constructed, rather than merely given by science *per se*. The recognition of this is no mere matter of semantics- rather the ways in which nature is represented likely will influence how society attends to environmental problems.

Clearly, the relationship between society and nature is not straightforward. Yet equally, the relationship between the social construction and the individual experience of the environment and the perceived tension between individual and society is not unambiguous as supposed individual experiences of the environment (such as cognition and perception) are largely contingent upon the societal construction of the environment (Graumann et al, 1990). Nature does not just confront the human observer- rather there is generally a complex interaction between both. Hence different cultural and social forms must be taken into account when investigating nature (Eichberg, 2000). When saying "nature", complex feelings and emotions are involved. For ex-

ample, nature is filled with social figures and mythical images, such as the lonely rider in the prairie, Tarzan, the witch in the dark forest, or the gardener. In that way, nature provokes humans to express an image of themselves as saying “nature” means to say something about one’s own identity (Eichberg, 2000).

Similarly, writing about Thoreau’s (1854) *Walden*, Kettle (2004; p.14) proposes that “*his real subject is not nature but the life of human beings*”. This may explain the recent interest of psychology in studying the relationship of nature and identity, which for instance, suggests that people’s engagement with nature contributes to the construction of social roles (e.g. Clayton and Opatow, 2003; Enticott, 2004). This is unsurprising, given the ways in which socio-cultural factors influence and construct nature representations. Unfortunately, this research avenue is in its infancy- the exact relationship between nature and identity is still unclear. Nevertheless, the importance of nature is becoming increasingly acknowledged in mainstream psychology. Hillman (1995; p.xxiii) questions:

“Sometimes I wonder...how psychology ever got so off base. How did it cut itself off from reality? Where else in the world would a human soul be so divorced from the spirits of its surroundings? ...Psychology, so dedicated to awakening the human consciousness, needs to wake itself up to one of the most ancient truths; we cannot be studied or cured apart from the planet.”

7.6 Conclusions Chapter Seven

In conclusion, our brief introduction to nature shows that, rather than being solely materially constituted, nature is in many ways socially constructed. In order to be able to account for the various important socio-cultural symbolisms that nature represents it is vital to investigate the concept from a social rather than an individual perspective. Thus there is an apparent need to move away from the positivist conception of nature to a more constructivist approach.

Unfortunately, past research has been largely in the tradition of individualistically oriented environmental psychology which means that empirical research into the broader symbolisms and values that nature incorporates has been neglected. But since today’s

environmental problems affect and concern the individual as well as society as a whole it is clearly legitimate to study these issues from a more social psychological viewpoint (Graumann et al, 1990).

In line with Sjoeborg's (2000; 2002; 2003) findings our focus groups results show that nature representations play an important role in lay risk perceptions of GM food. Yet thus far, nature representations and conceptions of naturalness have rarely been examined in depth and it is unclear what the concept of nature or messing with nature actually means for people. This is the aim of our free associations task which is presented in the following chapter.

8 FREE ASSOCIATIONS TO NATURE, FOOD AND GM FOOD

Our comparison of the expert and lay mental models showed that, in contrast to experts, lay participants' risk perceptions of GM food are influenced by the way they view nature, and more specifically, by the way the natural and the unnatural are contrasted. This has previously not been well explained, as the perception that "*GM is unnatural*" usually presents the culmination of an argument against GM.

This chapter presents the results of a free associations task which examines these concepts in more depth. The aim is to establish a comparative judgement by contrasting GM foods against other food and nature-related "things", and thus to provide a frame of reference. To investigate why GM is considered as unnatural, connotations of the "natural" are studied by looking at other familiar objects. By viewing GM food in the context of other reference points, it is possible to see the likely anchors and frames people use to make the judgement that GM foods are "*unnatural*".

Using a larger sample than in the first research stage, 188 participants were asked via a split ballot internet survey to freely associate to the stimulus words '*natural things*' and '*natural foods*', or '*food in general*' and '*GM food*'. Results were first analysed in EXCEL, providing frequencies of word associations, in order to be able to prepare the data for the subsequent analyses. The resulting data set was then analysed with correspondence analysis to summarise the detailed differences between the stimulus words. It is striking that associations to natural things, natural food, and food in general have many commonalities, while GM food stands alone and provides a stark contrast especially in comparison to natural food associations. As a third step, a cluster analysis was utilised to establish clusterings of word associations, showing which associations tend to be mentioned together. The resulting word clusters satisfactorily validate the findings of the correspondence analysis.

8.1 Research procedure- Part II

We first outline the research procedure before looking at the findings. To elicit free associations, we utilised an internet survey. The internet is an increasingly used method of social research and is becoming more and more acceptable, as the success

of for instance YouGov (1997) for political polling indicates. Here, polls showed exactly the same trends as on conventional polls during election period and also accurately predicted the final outcome of UK general election 1997. Further, it is more cost and time effective than face-to-face techniques, providing a good response rate in a limited amount of time as well as a higher quality of responses (Mehta and Sivadas, 1995). Lastly, online surveys cut out any interviewer effect.

Emails were sent out to various social scientific departments of the LSE, explaining the aims of the research, providing the researcher's details to verify her identity, and a link to the internet survey. These were followed up by two reminder emails sent two and four weeks after the initial contact.

Navigation to and of the survey was made easy with clear instructions at the top of the page. To secure as many responses as possible, instructions and the survey were kept short. In order not to make the respondent more self-aware of his/her identity, all socio-demographic variables were placed at the end of the survey²⁸. Instructions given to participants were as direct as possible, and incentives were offered for completion of the survey (please see table 8.1). Per stimulus word, five spaces (with a rating scale ranging from very positive to very negative) were provided.

Table 8.1 *Instructions for the internet survey*

This survey constitutes an essential part of my PhD research at the London School of Economics. Completion of the survey should not take longer than about 10 minutes, and two rewards (of £100 and £50 respectively) will be given to respondents chosen at random. The survey is anonymous, so results are strictly confidential. Hence if you would like to participate in the prize draw, it is essential that you include your email address at the end of the survey. Likewise, if you would like to be informed of the results of the study, please also provide your email address.

This is a free association task, so there are no right or wrong answers as the same object (such as red wine) can mean very different things to different people. I am interested in mapping the contours of people's feelings and thoughts that are associated with particular topics.

So, thinking about food in general²⁹, please list seven associations. Additionally, could you please indicate whether each association has a very positive, positive, neutral, negative, or very negative meaning for you by selecting one of the buttons below each association. Please remember that for research purposes, each section of the survey must be completed in full.

²⁸ The software used was written by Steve Bennett (Institute of Social Psychology, LSE). It consists of two scripts written in the PERL language that receive the data from the web survey page, and format it into a tab delimited database compatible with SPSS etc.

²⁹ And 'GM food' or 'natural food' and 'natural things'

The instruction contained three messages: a) information about the stimulus object, b) information about what to write down, and c) a request for the ratings. Instructions lacked information about how much exactly to write down, which slightly complicated the data analysis. However, not being restricted to a single word (as is common in free association tasks) enabled respondents to explain and elaborate their associations should they feel the need to. For instance, the association '*cooking*' in relation to '*natural food*' was surprisingly rated fairly negatively. Here it helped that respondents explained this by stating e.g. "*I don't know how to cook natural foods*" (male respondent, 32).

A split-ballot task was chosen, as a problem when presenting respondents with more than two or three word association tasks is the fact that they tend to produce less valid associations in later tasks, degrading the quality of the data (Wagner, 1997). Although administered at random, it was ensured that an equal number of responses to condition A and B were received, by including an equaliser component in the script. The survey was run for eight weeks (January and February 2005) when it was decided that the number of responses was sufficient for the planned analysis.

8.1.1 Participants

A different sample to the focus groups was used, as a) the number of focus groups participants was not sufficient, and b) they would have been primed on the task that followed. Internet surveys are limited to the extent that to date random sampling is not possible as no comprehensive online directory of email names exists. Moreover, even an online directory would not capture all the public. Hence a convenience sample of 188 participants (predominately students) who either had attained or were in the process of attaining a higher educational degree (MSc/PhD) was used. The mean age of participants was 27 years (SD 7.7 years); two thirds of participants were female and one third male.

8.1.2 Pilot study

The study was piloted with twenty participants. No problems were experienced in relation to the question wording, however the number of associations originally de-

manded (ten associations per stimulus word) was found to be too large as several participants did not come up with this number. Hence associations were limited to seven words per stimulus word, which Wagner (1997) agrees is the most feasible amount. Results of the pilot study were not incorporated in the final analysis.

8.2 Data analysis

The resulting data was analysed in three phases: a preliminary EXCEL analysis followed by correspondence analysis (CORA) and lastly, cluster analysis. The first research stage shows the frequencies of associations and ratings, i.e. which words are associated with which stimulus words and their average ratings and was essential in order to prepare the data for further analyses as suggested by Wagner (1997). The second research stage explains within each stimulus word, which associations are relatively more strongly associated with which rating. Leaving out the ratings, the final analytical stage explores which associations tend to be mentioned together. Both CORA and cluster analysis are explained in more detail in the relevant sections.

8.3 Phase A: Preliminary EXCEL analysis

The preparation of the word associations for further analysis was conducted with SPSS and EXCEL. The problem of often having not single words, but rather whole sentences as associations was solved by categorising the words through a theoretically informed categorisation scheme, after reading and examining the whole answers in detail. Lengthy associations were reduced to their keywords, e.g. *"I associate food with culture as food is different for different cultures"* (female respondent, 28) was coded as *'culture'*. It is acknowledged that some detail may have been lost in the translation. Especially in relation to the stimulus word *'natural things'* respondents answered in a very image-revealing way. However, since the aim of the research was not to investigate images of nature in detail, but rather, to examine in detail what is considered natural versus unnatural, the condensed version of results serves this task well.

Also to have a more manageable number of associations, data were further coded. For example, *'family'*, *'mother'*, *'grandmother'*, *'spouse'*, *'babies'* and *'friends'* were

coded as *'family and friends'*, keeping the most frequently and all-encompassing associated words.

Further, as in the ALCESTE analysis of the first part of the thesis, synonyms were homogenised and reduced to their stem, in order to clean the data for analysis and make it more manageable. For example, *'fat'*, *'fatty'*, and *'fattening'* were all coded as *'fat'*. Ratings were kept as on the internet survey itself, and comments were removed manually for separate analysis.

After this preparation, data was exported into EXCEL for the first analysis, so that data could be inspected for word frequencies and the remaining synonyms found and replaced. To develop the more refined coding frame for the further analyses data was examined in detail, and basic frequencies of words were calculated. The hence cleaned data was imported into SPSS for use with CORA and cluster analyses. The following section begins by looking at our EXCEL results presenting the forty most frequent associations for each stimulus word, with the mean rating of each association.

8.3.1 Results preliminary EXCEL analysis

8.3.2 Condition A: Natural things and natural foods

Table 8.2 shows that the most frequent associations to the stimulus word *'natural things'* are words describing physical features of the environment, such as weather conditions or types of animals. More interesting for the present analysis however, are various states of nature, representing nature on the one hand very positively in terms of purity, harmony and beauty, but on the other hand, more negatively in images of death, and unpredictability.

Second, assorted activities such as eating, smiling, and recreation are seen as *'natural things'*. In agreement with Fredrickson et al (1999) the experience of being in nature is often mentioned, implying that associations to nature extend far beyond the physical aspects.

Thirdly, words related to people (such as family and friends, love, and sex) are associated with natural things, indicating that respondents tend to see themselves and humanity as being part of rather than separate from nature, or in the words of Schultz et al (2004) as being “connected to nature”.

Fourthly, ‘*natural things*’ often evoke emotive associations, not only directly mentioned as ‘*emotions*’ but equally, in respondents’ descriptions of the meanings of their associations, such as ‘*spring awakening, freshness*’ (female respondent, 42). Here it is evident that nature is not only represented in material terms but rather that the concept has important symbolic and affective dimensions for participants.

Overall, ‘*natural things*’ are generally rated positively or very positively, with few exceptions, e.g. ‘*weather*’ largely received neutral ratings. The prevalence of the association of ‘*natural disasters*’ is likely the result of the timing of the research (Jan-Feb 2005), just after the devastating and well-publicised tsunami in South East Asia.

Table 8.2 Frequency table 'Natural things'

	Association 'natural things'	Rating of association* (mean)	Frequencies
1	weather	3	46
2	tree	2	45
3	animal	2	41
4	landscape	2	31
5	sea	1	27
6	water	2	25
7	flower	1	23
8	sunshine	1	20
9	love	1	17
10	sex	1	17
11	natural disasters	5	16
12	life	1	13
13	family and friends	2	12
14	emotions	3	11
15	earth	1	10
16	sky	2	10
17	recreation	2	9
18	eating	2	8
19	green	2	8
20	cotton	2	8
21	health	1	8
22	rocks	2	8
23	air	1	6
24	death	4	6
25	people	2	6
26	dirt	4	5
27	smiles	1	5
28	volcanoes	3	4
29	harmony	1	4
30	beauty	1	4
31	environment	1	4
32	nature	1	4
33	UN	3	3
34	fresh	1	3
35	blood	3	3
36	Greenpeace	2	3
37	Pleasure	1	3
38	Purity	1	3
39	Relaxation	2	3
40	Uncontrollable	3	3

*Ratings for associations were assigned by respondents, and coded as follows:

very positive = 1; positive = 2; neutral = 3; negative = 4; very negative = 5

Moving on to associations to the stimulus word '*natural food*', the most frequent associations in table 8.3 show that there is a very high frequency of food products which are only of limited relevance to the present study. But interestingly, there is also a va-

riety of associations related to the ways of food production, including '*straight from the farmer*', '*as nature intended*', '*home grown*', '*organic*' and '*not processed*' indicating an idealisation of natural foods. These traditional methods of food production are rated positively and hence clearly distinguished from negatively rated modern '*intensive farming*' techniques. Thus in agreement with Zwart (2000), respondents' concern with food today often centres around issues of food production, and it appears that the perceived naturalness of a food is a result of the way it has been produced, rather than the end product *per se*.

Respondents have clear representations of what is natural versus unnatural in relation to food. This is shown in the way natural and unnatural foods are contrasted. While the former receive strongly positive mean ratings of associations, associations such as '*processed food*', '*chemicals*', and '*McDonalds*' (which can be interpreted as industrially produced, or unnatural, foods) are unsurprisingly rated negatively. Despite not having been primed for GM food in the present research condition, respondents also associate '*GM food*', and surprisingly, this association is rated neutrally.

Further, natural foods are characterised as '*healthy*', '*fresh*', '*green*', as well as '*rare*' and '*expensive*', and associated with the activities '*farming*' and '*cooking*'. Apart from food *per se*, it is clear that this stimulus word (like '*natural things*') also represents '*purity*' and '*harmony*', essentially how things ought to be.

Table 8.3 Frequency table 'Natural food'

	<i>Association 'natural food'</i>	<i>Rating of association* (mean)</i>	<i>Frequencies</i>
1	fruit and vegetables	2	183
2	food product	2	99
3	meat and fish	2	47
4	health	1	31
5	organic	2	19
6	de-naturalised foods	5	11
7	not processed	2	10
8	straight from the farmer	2	10
9	taste	1	10
10	purity	1	9
11	expensive	4	8
12	farming	3	8
13	culture	1	7
14	Fairtrade	1	7
15	Fresh	1	6
16	Homemade	1	6
17	Mcdonalds	5	5
18	rare	4	5
19	as nature intended	2	5
20	vegetarian	3	4
21	cooking	4	3
22	harmony	1	3
23	my garden	1	3
24	nutrition	1	3
25	processed food	5	3
26	raw	2	3
27	supermarkets	4	3
28	tasteless	4	3
29	artificial	4	2
30	big	2	2
31	colour	2	2
32	big	3	2
33	countryside	2	2
34	environment	1	2
35	ethics	3	2
36	EU	4	2
37	goodness	2	2
38	meal	2	2
39	nature	1	2
40	virtuous	4	2

*Ratings for associations were assigned by respondents, and coded as follows:

very positive = 1; positive = 2; neutral = 3; negative = 4; very negative = 5

8.3.3 Condition B: Food in general and GM food

Similar to associations to '*natural food*', table 8.4 indicates that when participants think about '*food in general*', a large number associate various food and drink products. Yet thinking about food also evokes a broad range of related activities, such as cooking, eating, going to a restaurant, shopping, travel and work. Being associated with social events, enjoying the company of family and friends, sharing a meal and celebrating, shows how eating is perceived as a social act.

Moreover, food brings to mind a range of (mostly positive) emotions, such as '*pleasure*', '*love*', '*satisfaction*', and '*comfort*'. Evidently, food is an affective and sensory experience. Although the vast majority of associations are positive, food is not always perceived positively. From an individualistic perspective, associations such as '*fat*', the '*risk of weight gain*' and '*eating disorders*' show the concerns some participants have in relation to food. Thus while food can be both a source of pleasure or reward, it can also be regarded as a foe threatening health and the maintenance of a desirable body shape (Crouch et al, 2000).

Moreover, from a more societal perspective, participants are also concerned with the unequal distribution of food, and famine. In sum, our results show that food is far more than nutrition. Rather it is an emotive concept laden with a particular socio-cultural significance.

Table 8.4 Frequency table 'Food in general'

	Association 'food in general'	Rating of association* (mean)	Frequencies
1	food product	2	81
2	fruit and vegetables	2	54
3	meat and fish	3	40
4	drink	2	33
5	family and friends	2	26
6	culture	2	23
7	pleasure	1	22
8	social event	1	21
9	cooking	2	19
10	health	2	18
11	taste	1	18
12	fat	5	15
13	meal	2	11
14	hunger	4	10
15	diet	2	9
16	home	1	9
17	nutrition	2	9
18	essential	2	9
19	energy	2	8
20	relaxation	2	8
21	life	2	7
22	organic	1	7
23	satisfaction	1	7
24	risk of weight gain	4	6
25	mcdonalds	3	6
26	unequal distribution	5	6
27	comfort	2	6
28	celebration	1	6
29	delicious	1	6
30	company	1	6
31	colour	2	5
32	creativity	1	5
33	supermarket	3	5
34	restaurant	1	4
35	eating	2	4
36	eating disorders	5	4
37	emotion	2	4
38	famine	5	4
39	fresh	1	4
40	love	2	4

*Ratings for associations were assigned by respondents, and coded as follows:

very positive = 1; positive = 2; neutral = 3; negative = 4; very negative = 5

In comparison to the other food stimulus words, table 8.5 shows that GM food does not bring to mind as many food products; when it did, those were generally 'soya' and 'tomatoes', both well publicised GM food products. Also, GM food evokes the broad-

est range of associations, and compared to the other stimulus words, these tend to be rated rather negatively.

Table 8.5 *Frequency table 'GM food'*

	<i>Association 'GM food'</i>	<i>Rating of association* (mean)</i>	<i>Frequencies</i>
1	fruit and vegetables	3	66
2	food product	3	30
3	unnatural	5	30
4	science	2	22
5	helping third world	2	21
6	unhealthy	5	21
7	multinational companies	4	19
8	progress	2	15
9	potential benefit	2	14
10	environmental risks	5	14
11	dangerous	5	13
12	uncertainty	4	12
13	profit	4	11
14	exploitation	5	10
15	future	3	10
16	government lies	5	10
17	unknown long-term consequences	4	9
18	tasteless	4	8
19	big	3	8
20	not necessary	4	8
21	contamination	4	8
22	Greenpeace	2	8
23	supermarket	3	7
24	confusion	4	6
25	EU vs. US	4	6
26	GM animals	5	6
27	insufficient research	4	6
28	innovation	2	6
29	capitalism	4	6
30	cheap	3	5
31	chemicals	4	5
32	food tampered with	4	5
33	labelling	3	5
34	lack of control	5	5
35	mass production	4	5
36	political debate	3	5
37	suspicious	4	5
38	forced on public	5	5
39	bad	5	5
40	irreversible	4	5

*Ratings for associations were assigned by respondents, and coded as follows:

very positive = 1; positive = 2; neutral = 3; negative = 4; very negative = 5

Being described as unnatural, dangerous, unhealthy, tasteless, and unnecessary the characteristics of GM food are clearly distinguished from the characteristics of other foods. A remarkable group of GM food associations concerns their risks, both to the environment and to human health, as well as the exploitation of the third world.

However, GM food is not always rated negatively. Various associations are rated positively and it is evident that GM foods are perceived to have substantial benefits, such as helping the third world. This indicates respondents' ambivalence towards the issue which starkly contrasts with our focus group findings of the first research stage.

Notably, GM food, in contrast to both food in general and natural food, does not evoke similar food-related associations. Rather than thinking about the social significance of food, or home and family, respondents' thinking about GM food is anchored in images of on the one hand future, progress, and science, and on the other hand government lies, profit and capitalism.

Rather than being perceived as a "food" with all the social significance this entails, GM foods are perceived as belonging to the realm of science and progress- a complete opposite to homemade, organic food. And while science and progress in general are viewed positively, it seems that they do not have a space in the realm of food which is much preferred to be traditional, how it "used to be", and how nature intended. The generally positive associations to food indicate that participants like and enjoy the food they currently have and would rather not have it altered by science. This implies that rather than the technology *per se*, it may be its application to food that is problematic.

Moreover, similar to the results of our first research stage, a range of associations are concerned with the public understanding of science and the treatment of the public by government and industry. Participants lack trust in government (*'government lies'*), and feel confused and suspicious, often mentioning a feeling of being manipulated and forced into GM. Thus these issues clearly are a significant part of lay participants' representations of GM food, which cannot simply be divided from the food risk *per se*.

Interestingly, the stimulus word GM food evokes the widest range of additional comments by participants, often explicitly stating their lack of knowledge:

“I know very little about GM food, so could not make detailed comments I’m afraid. I don’t know if and how GM is positive, however, what I do know is that I don’t agree with this way of ‘progress’ as it is too risky for us, the environment and future generations.”

(female respondent, 47)

Thus in accordance with our previous focus group results, it is evident that lay representations of GM food incorporate far wider issues (often of a social and societal nature) than the scientific aspects alone.

Summing up, our preliminary stage usefully describes respondents’ associations, providing the frequencies and mean ratings for each association. This effectively allowed the data to be “cleaned” to pave the way for the further correspondence and cluster analyses.

8.4 Phase B: A background to correspondence analysis

Correspondence analysis (CORA) is an exploratory technique for analysing multi-way frequency tables, i.e. cross-classifications of two or more categorical variables. When a cross-tabulation has large numbers of rows and columns, it can be difficult to pick out all the important patterns in the data. CORA can help to summarise detailed differences between groups/conditions, and is used to reduce the dimensionality (i.e. the complexity) of a cross-tabulation. The technique aims to convert a table of numbers into a plot of points, usually on two dimensions, i.e. to represent the raw data in a low-dimensional space so that it is easier to identify the key features (Bartholomew et al, 2002).

Relationships between a row category and a column category may be assessed according to the proximity of their profile points on the biplot. Proximities must be interpreted with caution. If a point of row category one is closest to point of column cate-

gory two, we cannot say anything about the magnitude of their association in absolute but only in relative terms. For instance, it can be said that a pair of row-column categories (e.g. '*environmental risks*' and '*negative*' in the GM food biplot) that are close together are more strongly associated than a pair of categories that are further apart.

It is often possible to interpret and/or label the dimensions obtained from a CORA. This is done by examining the positions of row/column categories along each dimension and thinking about what row/column categories that appear close together have in common, and what distinguishes those that appear far apart. By attempting to interpret the 'meaning' of each of the dimensions the underlying structure of the data can be better understood. To interpret the biplots, dimensions can be named, but naming the dimensions in a CORA is always an arbitrary business. In our findings, dimensions are not always readily classifiable hence as suggested by Wagner (2001) we often focus on clusters of points, rather than dimensions. Any categories plotted close to the point where the two axes meet are deemed not to be particularly associated with any other category. Moving away from the origin where we can see clusters of points we can speak of a positive association. The closer the points are to each other in a cluster the greater the relative association. In sum, CORA can put the detail provided in the descriptive EXCEL report into some broader perspective.

8.4.1 Selection of words for CORA and cluster analyses

The preliminary EXCEL analyses prepared the word lists for further selection required for the quantitative analyses. The data of stage one was inspected for the relevant words. The relevant words are those with a bearing on the stimulus and with a reasonable frequency in the sample to expect contingencies (Wagner, 1997). Hence, for each stimulus word, a fairly large number were excluded, for example, in relation to food, all food and drinks products (which, when combined, made up the most frequent words) were excluded³⁰. In relation to the stimulus word nature, word associations of the physical aspects of nature were excluded from further analysis. The main reason for cutting off words with particularly high frequencies is that in a CORA high frequency words are assigned an often unduly high mass, separating them more than

³⁰ In relation to natural food associations, as the first part of the thesis, codings were condensed to the extent that pesticides, hormones, GM, and chemicals were all coded under '*de-naturalised foods*'.

may be desired from less frequent words in the resulting correspondence space (Wagner, 1997).

The problem that once the very frequent words were excluded, there was not clear cut-off point was alleviated by including the twenty most frequent words per stimulus word. This is an arbitrary cut-off point but trying various word numbers for the CORA showed that this was the most feasible amount- any more and the resulting correspondence space was not interpretable anymore. Also, in order to have visual clarity in the correspondence spaces, lengthy codes such as *'family and friends'* were abbreviated to *'family'*.

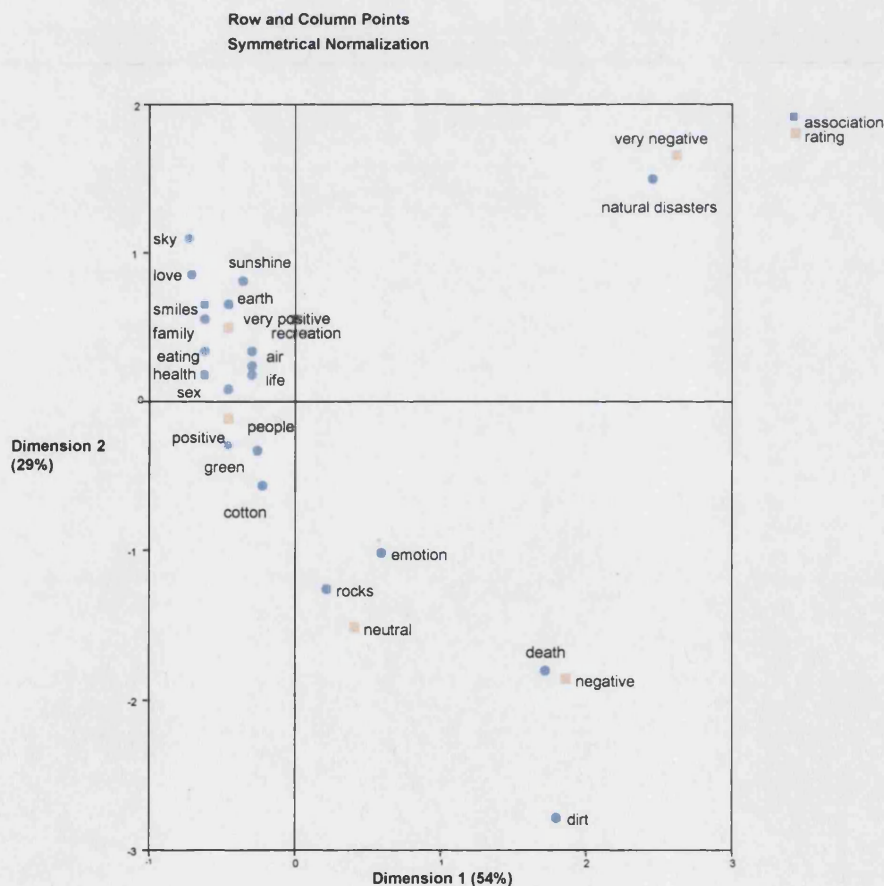
The results of both CORA and correspondence analysis are presented separately before we summarise our conclusions at the end of the chapter.

8.4.2 Results correspondence analysis

8.4.3 Condition A- Natural foods and natural things

Figure 8.1 shows the biplot resulting from associations to natural things³¹. Dimension 1 follows the line of positive to negative ratings, while dimension 2 is more difficult to classify, hence as suggested by Wagner (1997) it makes sense to look at the clusters of associations. At the centre is a cluster about nature which is rated very positively, and at either extreme, associations are rated more negatively, especially 'natural disasters'. Yet despite being aware of nature's darker sides that need to be respected, it is shown that generally, respondents represent nature as a realm for positive activities and with life-giving properties.

Figure 8.1 Biplot natural things



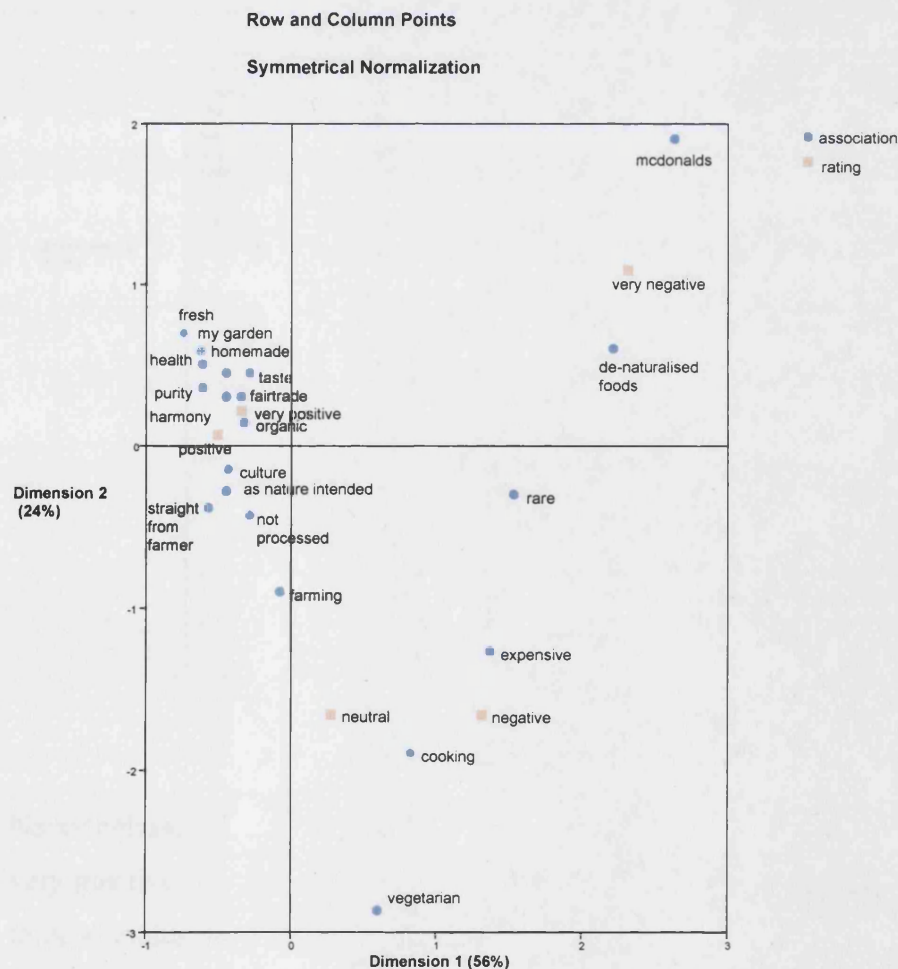
³¹ The relevant correspondence tables showing associations with detailed ratings for all stimulus words can be found in Appendix D.

Regarding 'natural foods', similar to above, figure 8.2 indicates that dimension 1 goes from positive to negative evaluations, with natural states such as 'purity' and 'harmony' being viewed very positively contrasting with man made variations of our food, such as 'de-naturalised foods'. Dimension 2, rather than just describing characteristics of natural foods, implies a value orientation in respect to how food should be: 'straight from the farmer' and 'as nature intended'. This contrast between the positive and the negative associations might allow respondents to distinguish themselves from others and so acquire a moral identity of their own:

“By accepting certain labels and rejecting others, the contemporary food consumer is allowed to develop a moral Self, to live a morally examined life and to take sides in the political conflicts of the present”

(Zwart, 2000; p.125)

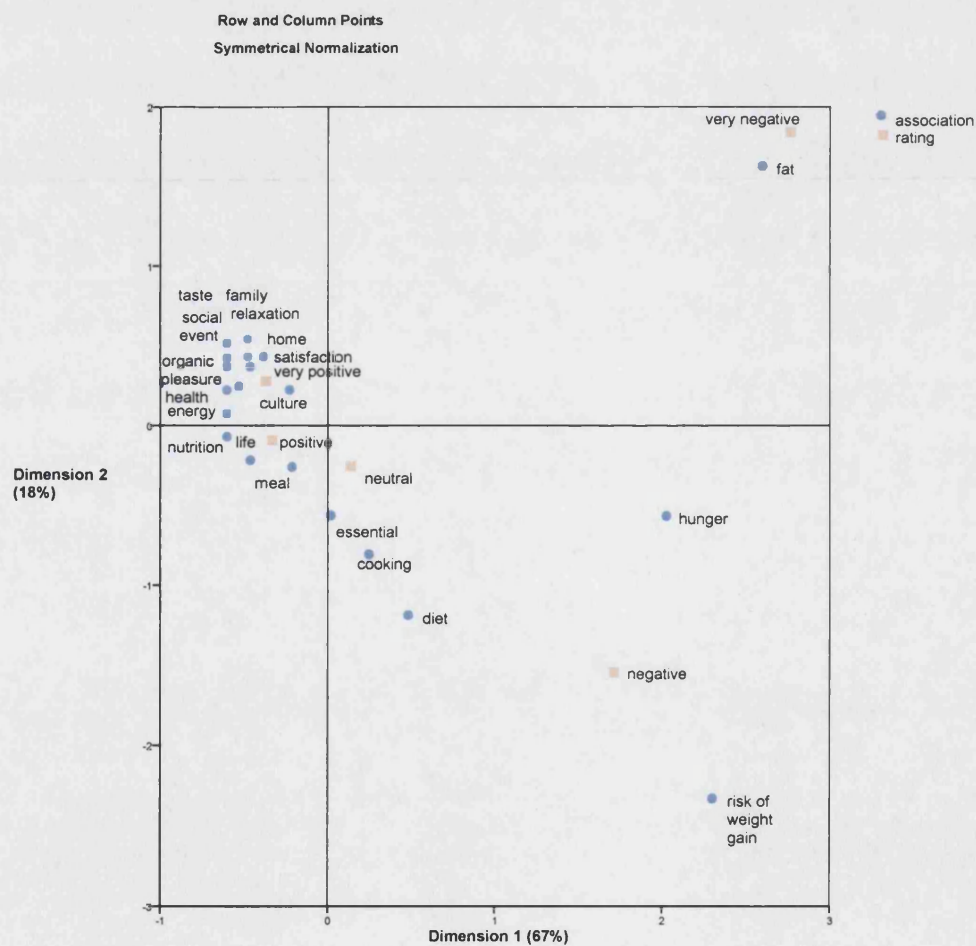
Figure 8.2 Biplot natural food



8.4.4 Condition B- Food in general and GM food

Regarding food in general, figure 8.3 shows that dimension 1 goes from positive to negative ratings. Again, there is a strong clustering of positive and very positive rated associations, centring around the social as well as material significance of food. For example, socially food is associated with pleasure and culture, and more physically with nutrition, energy and life. Dimension 2 also incorporates both these aspects, with the social significance of food outweighing any physical practicalities. Negative associations focus mainly on diet, and weight gain- associations that may be a reflection of a society pre-occupied with slimness and looks.

Figure 8.3 Biplot food in general

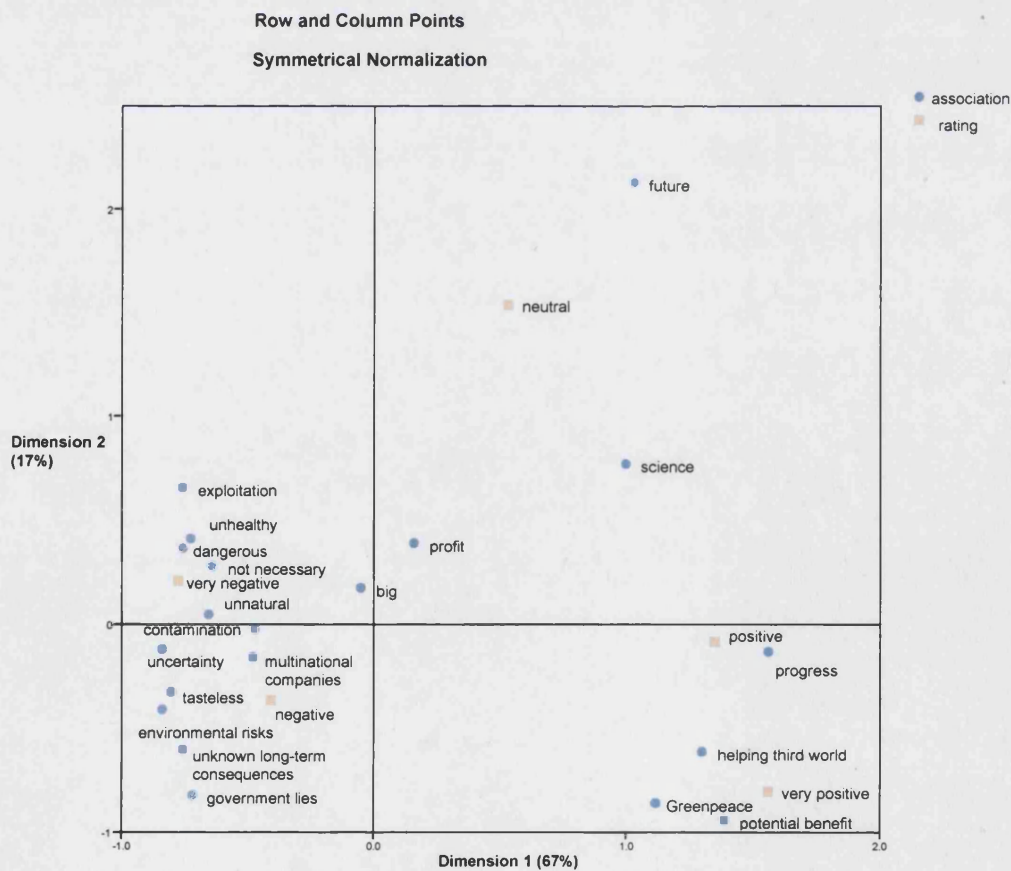


Nevertheless, as with associations to 'natural things' and 'natural foods', positive and very positive associations are clearly predominant. Interestingly, associations to these three stimulus words have several commonalities, which is not surprising for the food

related associations. However, associations to food in general and natural things also share similarities- in both conditions 'family (and friends)' and 'life' are very positive associations. The association of 'health' is shared between all stimulus words apart from GM indicating that respondents view being healthy as our natural state, which is changed by GM into an unhealthy and unnatural state.

Hence these findings contrast sharply with respondents' GM food associations as shown in figure 8.4. GM food shows two clusters, the larger one being rated negatively but a significant other cluster rated positively, showing a clear duality of associations in contrast to our focus group findings. Moving from negative over neutral to positive associations to GM food, dimension one shows participants' ambivalence about the issue, indicating that participants were able to see both risks and benefits, albeit not in equal measure.

Figure 8.4 Biplot GM food



Clusterings that can be observed in the negative realm along dimension 2 focus of the perceived characteristics of GM food, their risks, as well as public trust in the behaviour of government and industry.

As GM foods are perceived as '*unhealthy*', they strongly contrast with the importance of '*health*' established in relation to the other stimulus words. As could be expected, there is a duality especially between associations to GM and natural foods. GM foods are tasteless as opposed to (generally) tasty, unnatural as opposed to as nature intended, a source of contamination as opposed to purity, and exploitation as opposed to fair-trade.

On the other hand, GM foods are also associated with progress which is perceived positively, and science which is perceived rather ambivalently. This shows that as in our focus groups, respondents clearly are not technophobic. In turn, this hints at the notion that there may indeed be something special about food risk perception, which may be the result of the social significance of food established for the other stimulus words, which is simply not shared by GM food.

In sum, the CORAs show that associations to GM food are very different to other stimulus words which share a lot of commonalities. Further, GM foods characteristics contrast to those of other foods in the perception of what is a natural versus an unnatural food, with participants distinguishing between naturally and industrially produced foods.

8.5 Phase C: A background to cluster analysis

As a third step, data was examined with cluster analysis to investigate which associations tend to be mentioned together. Cluster analysis groups cases or variables (in our case associations) in such a way that those allocated to a particular group are in some sense close together. One can then examine the clusters and ask what those which appear to be similar have in common. The present research uses hierarchical (as opposed to non-hierarchical) cluster analysis, which means that the clustering process yields a

hierarchy in which subsets of clusters at one level are aggregated to form the clusters at the next, higher level.

One of the most frequently used graphical representations of results is the dendrogram, or tree diagram. The dendrogram is interpreted as follows: stimuli are assembled according to their decreasing similarity rated on a scale ranging from the left to the right of the diagram. Thus the already classified groups of stimuli are in turn classified into other groups until all responses are assembled in a single group whose degree of similarity can be read of the diagram. The resulting hierarchical cluster tree is a hierarchy of groups that fit together.

For the present study, various measures of cluster analysis were tried out and compared. The different measures often gave similar clusters, indicating robustness, i.e. that one can have confidence that they are reflecting some aspect of the data faithfully. Present findings are based on the Centroid method, using the Jaccard similarity coefficient. An outline of the procedure for cluster analysis using this method is provided in Appendix E. As variables are binary, a measure of similarity (or distance) could be based on the proportion of respondents on which two variables match. The Jaccard measurement does not presuppose that the fact of mentioning an item is equivalent to not mentioning it hence variables that match purely on the criterion of being 'not present'³² are excluded from the calculation. This means that when calculating the similarity coefficient between two variables (i.e. associations), respondents who mention neither of those two variables are excluded from the formula. There is no need to go into the details of the algorithms here as the method is used in a purely exploratory fashion to suggest possible clusterings³³.

8.5.1 Results cluster analysis

8.5.2 Condition A: Natural things and natural food

Looking at figure 8.5, in the dendrogram for '*natural things*' the cluster analysis reveals six clusters, which only meet at the final stage, indicating that they are relatively

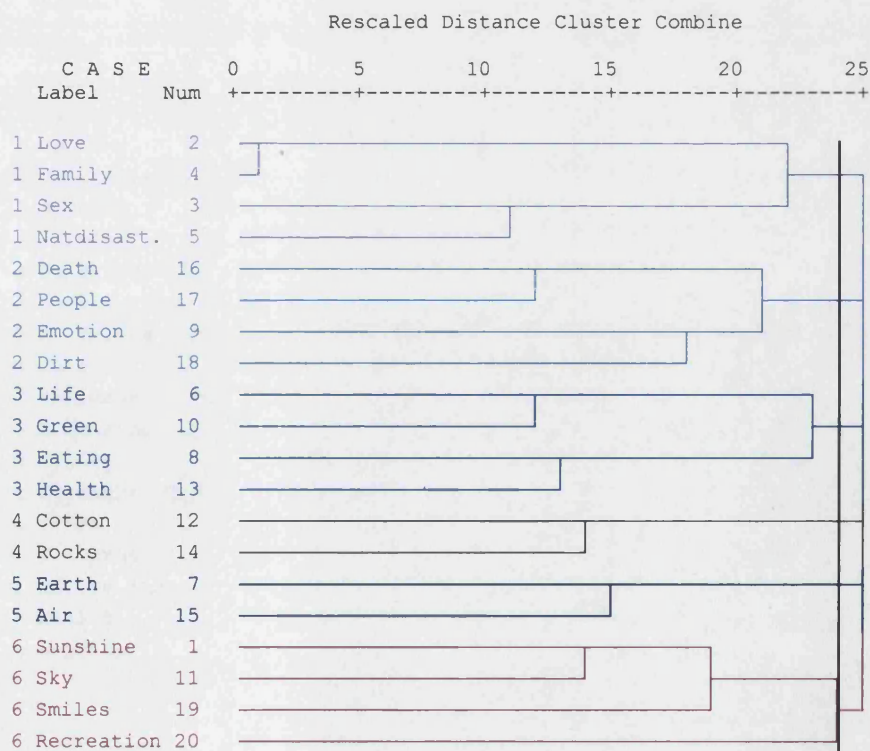
³² Such similarity indexes are more relevant when subjects must explicitly indicate that they accept or reject a suggestion, which was not the case in our study.

³³ For technical details, please see for example Everitt, Landau and Leese (2001).

separate from one another. Cluster 1 centres around family. The very first agglomeration of the cluster occurs between the associations 'love' and 'family' indicating that they are more similar than any other associations. Natural disasters being part of this cluster may signify that when thinking about natural disasters, participants readily think about the human costs of say, the tsunami, rather than the physical forces of nature *per se*.

Slightly similar in its characteristics, cluster 2 also focuses on people as well as the more negative sides of nature, such as death and dirt. Cluster 3 seems to be organised around important aspects of life, highlighting the prerequisite of eating for health, and of health for a good life. Clusters 4 and 5 focus on the physical aspects of nature, and are hence of lesser relevance for the present study. Despite including physical aspects such as 'sunshine' it is clear that cluster 6 focuses on recreation and activities in nature, evoking pleasant imagery. Hence although respondents often associate nature with its physical characteristics, it is evident that representations of nature go far beyond these aspects, incorporating social and affective dimensions.

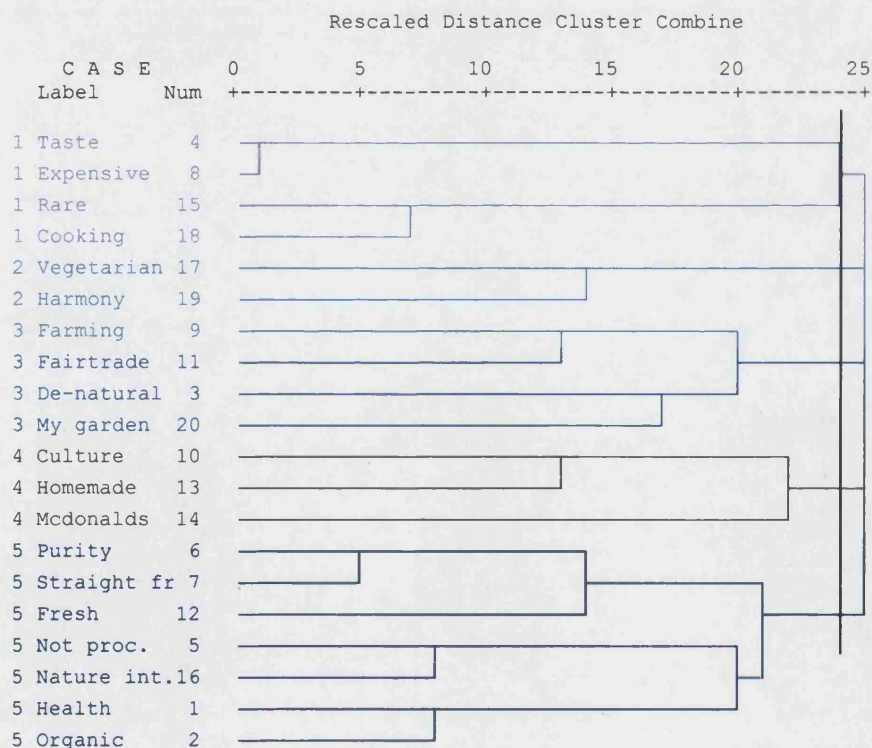
Figure 8.5 Dendrogram using Centroid Method: Natural things



Examining associations to 'natural food' in figure 8.6, five clusters can be determined, with the first and second clusters focusing predominately on the perceived characteristics of natural foods. The third cluster is organised around various kinds of food production methods, and looking back at the CORA, it is evident that the association of 'de-naturalised foods' (a very negatively rated association) is included to put natural foods into context by offering a sharp contrast. Rather than farming culture, cluster 4 centres around food preparation culture, with 'McDonalds' being included as a negative example which is relatively loosely associated.

Cluster 5 is the largest and most interesting. It seems to present an idealised version of how natural foods should be: pure, straight from the farmer, fresh- as nature intended. Especially the former associations are closely related indicating that food which comes straight from the farmer may be perceived as pure and healthy, although technically this is not necessarily the case (Enticott, 2003).

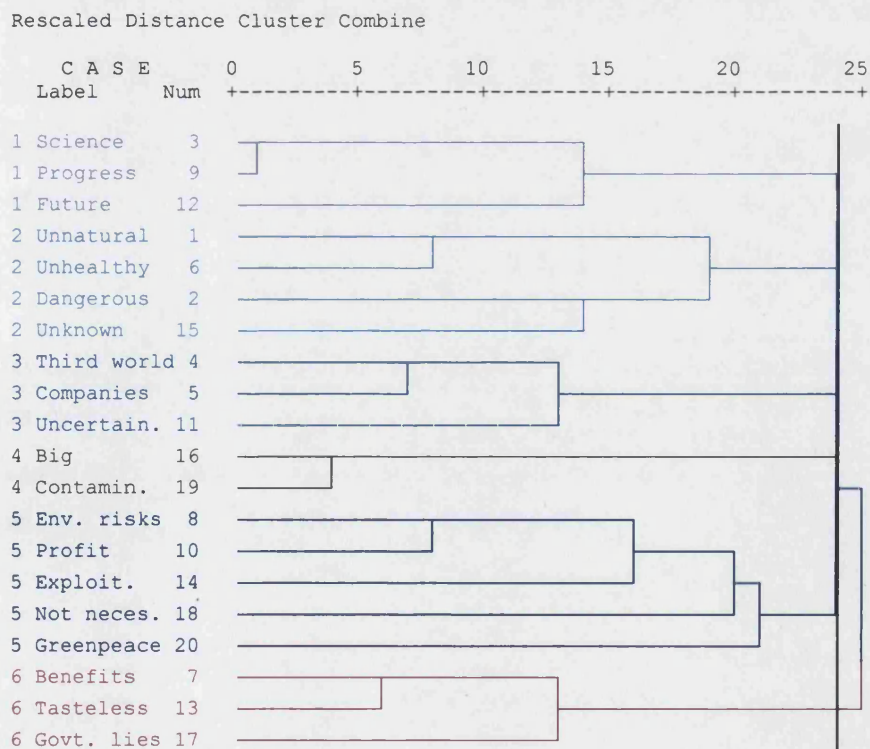
Figure 8.6 Dendrogram using Centroid Method: Natural food



Regarding associations to GM food in figure 8.8, it makes sense to look at six clusters that only meet late in the analysis, indicating relatively loose associations between them. The first cluster can be readily identified as focusing on science and progress, with these words being closely associated.

The second cluster centres on the characteristics of GM food, for example, the unnatural is closely associated with the unhealthy, the unknown (consequences) with the dangerous. In the third cluster, it is evident that helping the third world and multinational companies are closely associated, yet only by referring to the CORA does it become clear that while the former is clearly viewed positively, the latter tended to be assessed as negatively. In turn, this may indicate why the same cluster also incorporates concern about uncertainty- GM may be able to help the third world but the involvement of multinational companies makes the end result questionable. This interpretation would corroborate findings of the focus groups, where industry was simply not trusted to deliver their promises of feeding the third world.

Figure 8.8 Dendrogram using Centroid Method: GM food



Furthermore, albeit small, cluster 4 is interesting in that it resonates with previous Eurobarometer analyses (1996; 1999) whereby GM food is associated with adulteration, infection of some kind, and monstrosity. As established by Gaskell, Allum and Stares (2002), these are common menacing images of GM food, held by about 25 percent of Europeans³⁴. This is unsurprising because especially tabloid-style newspapers covered biotechnology issues in a menacing way (Wagner and Kronberger, 2001) and these of course are a resource for representing the issues for the people who read these papers.

Cluster 5 addresses the potential risks of GM food, which are both of a moral (exploitation and profit) as well as of a scientific nature (environmental risk). Hence it is not surprising that (albeit fairly loosely related) Greenpeace is associated with cluster 5, as it may have been this group who shaped respondents' awareness of the environmental issues surrounding GM food. Implying a value orientation, the perception that GM food is not necessary is not only related to the environmental risks, but equally to exploitation and the quest for financial profit.

Cluster 6 is not readily identifiable under a particular thematic area. However, it seems that both the perception of potential benefits and the perception of GM food as being tasteless are quite closely related, maybe indicating that both the positive and negative aspects of GM foods are weighted up to some extent. Relatedly, the problem of lack of trust (*'government lies'*) may make it more difficult for participants to actually believe agents advocating the benefits of GM.

To sum up briefly, the above cluster analyses largely confirm results of the CORAs, as both group together similar clusters. Thus present findings appear to validate each other, as well as providing a different way of clustering the associations which helps to make better sense of the clusters.

³⁴ For instance, the knowledge quiz in the Eurobarometer survey contains the statement *'genetically modified animals are always bigger than ordinary ones'* which 25 percent of Europeans considered to be true (Gaskell et al, 2002).

8.6 Summary of analyses and Conclusions Chapter Eight

In conclusion, our findings show that the descriptive EXCEL analysis, CORA and cluster analysis are best considered jointly to give as full as possible an impression of word association relationships. The first research stage showed the frequencies of associations and ratings, i.e. which words were associated with which stimulus words and their average ratings. The second research stage explained within each stimulus word, which associations were relatively more strongly associated with which rating, while the final research stage explored which associations tend to be mentioned together. In agreement with Wagner (1997), no method taken by itself is the one and best way for the analysis of free associations data but applied together, we could see remarkable patterns emerging.

We can draw four main conclusions. First, our analytical approaches show how participants represent the natural and how the “natural” and the “unnatural” are contrasted. Food in general, natural foods, and natural things overall are rated very positively, with GM food offering a sharp contrast in several ways. When looking at other negatively rated food associations, such as *‘de-naturalised food’* and *‘intensive farming’*, it becomes evident that the way of food production (rather than the end product *per se*) is an important decision point when judging a food to be natural or unnatural. Being perceived as a product of science, rather than of nature (as food “ought to be”), clearly contributes to GM food being represented as unnatural.

Second, maybe because GM food is anchored in images of science and progress, it is not attributed the kind of social significance which our results highlight for the other stimulus words. It is clear that rather than solely providing nutrition, food has important socio-cultural dimensions which are not shared by GM food. Also, eating is considered a natural activity, and by being unnatural GM disturbs this natural order of things, and may in turn signify danger.

Third, like food nature has a strong social dimension. Nature and the natural mean far more to respondents than the physical aspects according to the positivist paradigm and established by environmental psychology. Rather, nature representations incorporate a wide range of affective and symbolic elements. Looking at these (generally very posi-

tive) constructive elements of nature highlights why participants may be so averse to the unnatural. In relation to food at least, the unnatural clearly contrasts with respondents' socio-cultural values. Moreover, because nature tends to be perceived as pure and harmonious, a technology such as GM which is regarded as contaminating may upset this balance, putting the world as known at risk.

Fourth, the quantitative analyses of associations to GM food in many ways validate the qualitative analyses of our first research stage. However, some interesting differences could be observed, too. It is clear, that in addition to its risks, our free associations respondents also perceived GM foods to have significant benefits, indicating their ambivalence towards the issue. This shows the added value of quantitatively oriented research that allows for a larger sample size. Regarding our focus group findings it is possible that group dynamics resulted in a polarisation of opinions, starting off negatively and becoming fairly one-dimensional. In contrast, our free associations task is likely to have benefited from limited group and researcher influence. Nevertheless, it should be noted that even this larger sample was fairly specific in terms of their characteristics. The following chapter compares and contrasts the findings of both research stages in more detail.

9 DISCUSSION

The research reported in this thesis was conducted in two parts. The overall aim of the first research part was to explore expert and lay perceptions of GM food risk using the mental model approach to risk communication, developed at the Carnegie Mellon University (Granger Morgan et al, 2002). The Carnegie Mellon University (CMU) approach offers a systematic procedure for finding out what people know about a risk, and what they actually want to, and potentially need to, know about it. The approach appreciates that existing knowledge is likely to influence the reception and understanding of any new information. Hence in order to devise effective risk communications, the CMU approach first establishes existing expert and lay knowledge about a risk. However, because of the underlying positivist and rationalist assumptions of this approach, we synthesised the CMU approach with social representations theory (SRT) to “socialise” mental models.

The CMU approach had not been applied to gene technology generally, and regarding GM foods specifically, only few studies directly compare expert and lay risk perceptions in detail. Thus, the first part of the research investigated expert and lay risk representations of GM food in depth, in order to explore how risks are understood by both groups.

The exploration of the CMU approach led us to focus on the non-scientific issues within the GM food debate and how, if at all, the CMU approach might deal with those. One of the significant non-scientific issues was lay participants' concern that GM is '*messing with nature*'. This is an empirically unexplored area, in contrast to for example trust, hence in the second part of the thesis, “nature” was investigated further. The aim of the second study was to explore what people actually mean when they say that '*GM is unnatural*' and what frames and anchors they use to make this judgement. For this, we utilised a free associations task to show what attitudes, images and linguistic repertoires guide lay people's thoughts on and discussions of nature, food and GM.

The present chapter discusses above results putting them into their theoretical contexts. Limitations of the thesis and avenues for further research are explored, before conclusions are drawn and implications for risk communication are outlined.

9.1 Summary of findings: Part I

In line with the CMU approach to risk communication, nine scientific experts on agricultural biotechnology were interviewed in order to map GM food risk based on science. As a second step, and using a topic guide based on the expert findings, five focus groups with lay participants were conducted. The transcripts of the elite interviews and focus group discussions were explored with ALCESTE to give a first overview of the findings, followed by an in-depth analysis with Atlas/ti. Results of this analysis provided the basis for constructing expert and lay mental models. These were compared and contrasted, showing how expert and lay participants represent GM food risk.

9.1.1 Overview ALCESTE analysis

ALCESTE is a tool for determining the main word distribution patterns within a text, by obtaining a primary statistical classification to reveal the most characteristic words and patterns. The underlying idea is that the meaning of a text can be captured if one finds those words that occur together and are produced by as many respondents as possible (Kronberger and Wagner, 2000)

Our exploratory ALCESTE analyses highlighted significant expert and lay divergences in risk perceptions of GM food. While experts generally focused on the scientific aspects, lay participants took much broader issues into consideration when discussing GM food risk. These differences were not solely the result of different levels of scientific knowledge, as the inclusion of social and societal considerations for lay participants indicated. This was particularly evident in relation to *'nature'* whereby lay people appeared to attribute far wider symbolic meanings to the concept than did experts. Furthermore, levels of trust and attitudes to regulation differed greatly between both groups. While experts largely trusted the regulatory regimes in place, lay participants were distrustful, regarding the interplay of science, politics and industry

as problematic. Finally, the largest cluster of the ALCESTE analyses for the experts concerned the public understanding of science, and for the lay participants, the understanding of science and politics, indicating both groups' interest in the issue of science and society.

9.1.2 Overview ATLAS/ti analysis

Following from the exploratory ALCESTE analysis which helped to establish general discursive categories, Atlas/ti was utilised to investigate the particularities of expert and lay discourses of GM food risk in depth. Atlas/ti is a tool for the analysis of qualitative data, which speeds up the coding process and provides a more complex way of looking at relationships of themes in the data. Of particular relevance to the present thesis was its ability to create visual code networks, which formed the basis for our mental models.

The findings show that expert and lay people represent GM food risk rather differently basing their different risk and benefit perceptions on different underlying values and norms. In essence, dissimilar representations of the issue are brought into the risk assessment. These would need to be acknowledged when designing risk communications. The results of the Atlas/ti analysis are discussed in detail in Chapter Six. Thus the following summary only focuses on the issues whereby expert and lay participants differ significantly, and which at the same time demonstrate the limitations of the science-based mental model approach. We highlight three specific areas: a) scientific uncertainty/ambiguity, b) trust, and c) non-scientific issues, such as values related to nature.

9.1.3 Scientific uncertainty

With regards to the uncertainties about the risks and benefits of GM food, the findings show that there are notable areas of expert disagreement. For instance, while most experts focused on the benefits of GM (rather than the risks) there was disagreement about what these are and when society will experience them. Likewise, experts disagreed about the potential effects of GM on the environment (an area that lay partici-

pants were also concerned about), and more specifically, about whether to construe these environmental impacts as “harm”.

Hence unsurprisingly a particular area of concern for lay participants is scientific uncertainty, as important and relevant information is perceived to be missing. Scientific uncertainty poses a problem, because in the words of Rosa (1998) lay participants regard GM food risk as a “post-normal risk”, opening up questions that are both unknown and unknowable. For the CMU approach, it is a challenge how to proceed on such issues, where even for the experts, unequivocal information is simply not available.

Looking back at Funtowicz and Ravetz’s (1990) distinctions between different types of uncertainty as outlined in Chapter One, GM food risk falls into their categorisation of “border with ignorance”, i.e. uncertainty about model completeness and uncertainty due to lack of knowledge. Renn et al (2002) categorise GM food risk as “ambiguity” as distinct from uncertainty. In both frameworks, the technology falls in the most problematic type of risk conflict. For Renn et al such risks can only be resolved through participatory discourse rather than science single-handedly. Accordingly, it is likely that the provision of scientific information alone as suggested by the CMU approach would be insufficient to clarify, let alone resolve, the conflict over GM food.

9.1.4 Trust

Yet inadequate risk assessment is not only due to inadequate scientific knowledge—scientific facts are often uncertain. Rather the findings indicate that judgements about uncertainty in science reflect the trust in the agents addressing the uncertainty. Lay participants expressed the desire to be able to trust experts, but did not consider this to be possible in the present societal climate. Participants had a strong sense of recreancy, i.e. perceiving government, science and industry to have failed to carry out their responsibilities with the vigour necessary to merit societal trust (Freudenburg, 1993). In line with previous research³⁵, the findings show that trust and risk both cannot be

³⁵ The relationship of trust and risk is addressed here only in passing as the concept has received copious amounts of attention in the literature (e.g. Slovic et al, 1991; Kasperson, 1992; van Ravenswaay, 1995; Siegrist, 2000).

seen in isolation. As suggested by Luhmann (1979) they are two sides of the same coin. If scientific advice is not trusted, people perceive an increasing exposure to risks of both individual and societal nature.

There was not only lack of trust but a culture of suspicion, as lay participants felt that they had been lied to, and conspired against, hence the motivations of scientists, government and especially industry were strongly questioned. GM was perceived to exist and to be promoted for all the wrong reasons, thus lay participants want to know who is setting the agenda for science, based on which underlying criteria.

In this way, one cannot distinguish the communication from the communicator, as regardless of the content of the communication, trust in the message, communicator and intentions seems to be a pre-requisite for successful communication. As such, trust (or lack of) presents a significant problem to risk communication exemplifying a further limitation of the CMU approach. Even if the communication could address all the issues the public is worried about, the perception that the information source is unreliable is problematic- whom to trust to tell the truth? If trust is lacking, it is doubtful whether the message can reach recipients as intended at all. Focusing primarily on the development of the communication content the CMU approach neglects this vital issue.

9.1.5 Non-scientific dimensions in risk perceptions

In addition to trust-related issues, the application of the CMU approach demonstrates that major distinguishing factors between expert and lay participants are often related to various other non-scientific factors, such as values. For lay participants, these issues are pressing and important, while experts, at least when talking about GM food, tend to neglect them.

For example, experts generally believed in technological solutions to societal problems, while lay participants did not necessarily think that technological innovation will solve the world's problems. Clearly, these are value, rather than knowledge, related concerns. Values are associated with people's views about the contribution of science and technology to the quality of life, and with the extent to which they are

prepared to support developments such as GM foods (Gaskell et al, 2004). Hence our results indicate that GM is controversial, in part, because the technology engages with people's beliefs and values.

Furthermore, although in contrast to lay participants, experts mostly perceived the current regulation as satisfactory, even experts disagreed about a number of regulatory issues. For instance, while most experts anchored GM food risk in the risks of other novel foods, arguing that the end products are substantially equivalent, others did not find this a valid basis for assessment. Hence it is not surprising that controversy is apparent particularly in the area of regulation. Moreover, even for experts, there were problems of risk definitions such as shown in the discussion of what constitutes harm to the environment. This indicates the social construction of both risks and benefits as various scientific 'facts' can be interpreted in different ways by different groups. In turn, these interpretations likely are based on different underlying values and norms. Within regulation at least, science cannot easily be divided from values. While science may be able to determine what the risk is, whether it is perceived as being worth taking (i.e. its acceptability) is determined by societal values.

9.1.6 "Messing with nature"

A frequent value-related concern is lay participants' perception that '*GM is messing with nature*' and is '*unnatural*', issues which find no place in purely scientific thinking. While experts spoke about the environment in largely physical and/or spatial terms and focused on the agricultural application of GM, for lay participants, nature had broader connotations, many with affective overtones. When discussing GM food risk lay participants were concerned with the relationship of humanity and nature, the prevailing perception being that one should not change nature in unnatural ways. Often participants used '*messing with nature*' as a clinching argument which required no further elaboration. In this sense, nature is associated with a deontological position in that it is wrong to mess with nature in any circumstances.

This was coupled with an idealistic view of nature, where everything fits together in harmony and hence should not be disturbed. This romantic rather than Darwinian representation of nature may serve group identity, justify environmental advocacy or

simply serve the attitudinal function of evaluating GM (Bauer et al, 1999). Experts on the other hand appreciated that modern agriculture and food production is no longer natural, however, it is doubtful whether this viewpoint could alleviate public fears at all, as lay participants perceived GM as *another* step in the wrong direction.

In particular, lay participants rejected the idea of mixing species that could not occur through natural selection. In this way, plant to plant transfer might be acceptable but combining plant and animal genes would transgress natural boundaries. It is a cultural taboo³⁶, whereby mixing different species is perceived as unacceptable, which relates back to the fear of monstrosity as suggested by Wagner et al (2004). Participants have a moral concern about interfering with nature, and of transgressing natural boundaries by unnatural means. By changing the nature/essence of our food, GM food transcends those natural boundaries, making it appear risky. In comparison to other alterations of food (such as pesticides) the taboo here is that the essence of the food is changed by inserting a foreign element, rather than something being added on, which can be 'washed off'. In that sense, the perceived contamination goes to the core and cannot be readily decontaminated.

In relation to contamination, food may be a special issue in the way its risks are perceived because incorporating dangerous substances into the body, such as through eating is often more profound than many other types of behaviour involving risks as it breaches the boundary between the body and the external world (Rozin and Fallon, 1987). Some further reasons for the particularities of food risk perception are elucidated in the second part of the research.

Due to its food-specificity, for lay participants, the risk of GM food was frequently anchored in BSE risk. In this context, Slovic's (1987) characterisation of the dimensions of risk shows that both risks have various dimensions in common, such as their involuntariness and dreaded consequences. BSE also clearly contributed to the destruction of public trust in regulation. While experts viewed the case of BSE as an exception, lay participants saw it as representative illustration of what is wrong with our

³⁶ Indicating the cultural and social construction of boundaries and taboos, in eastern cultures the mix of species is often viewed more positively, as man-animal combinations (such as the sphinx or various Hindi godly creatures) are seen as possessing the wisdom of both creatures.

food today. Food production seems to have become stigmatised in the UK due to BSE, foot-and-mouth, the addition of hormones, and other scandals. As suggested by Zwart (2000), lay participants were concerned with the unnaturalness of modern food and food production methods in general, not only the application of GM. These findings provided the basis for the second research stage which aimed to contextualise GM food representations by looking at other food- and nature-related 'objects'.

9.2 Conclusions Part I

With reference to Fleck (1935), the results indicate that expert and lay participants often employ different thought styles based on different underlying values when thinking about GM food risk, making communication between the scientific and the more intuitively common sense language challenging. Evidently, these barriers need to be broken down to facilitate more productive communications.

Reflecting back on the problems of risk communication outlined in Chapter Two, it is evident that the only problems that the CMU approach could help to alleviate are those related to the content of the message. In effect, in relation to GM food risk, all that the approach can do is to show how the lay mental model differs from those of the experts. But understanding expert and lay risk perceptions in line with the CMU approach is only a valuable first step and not sufficient to resolve the social controversy over GM food.

The controversy arises precisely because GM food risks are in part social. They are representations that have socio-cultural and value dimensions. If one looks at the different dimensions of GM food risk, it is apparent that the scientific dimensions are less problematic than the social and moral ones. For lay participants, a far wider range of issues come into play beyond the scientific risk of GM foods, which indeed is not the greatest concern. The gap between expert and lay knowledge may be a challenge to effective communication but not necessarily the major one.

Rather, there are two other key hurdles to risk communication: problems related to trust and lay concerns about non-scientific issues, such as social values and concep-

tions of nature. Because these are social and societal issues, they cannot be resolved through the application of the science based CMU approach alone. Thus the following section shows how, for the study of GM food risk, the CMU approach benefited from being synthesised with social representations theory.

9.3 Conceptual implications for risk communication

Recognising that GM food risk is not just a scientific reality but, at least in part, a social construction has two important conceptual implications for risk communication. Firstly, it means that one needs to move beyond the information deficit model towards an approach that appreciates the social correctness of lay views. Secondly, characterising risk representations as social, i.e. shared, means appreciating their social and cultural origins. In turn, this implies that *individual* attitudinal change approaches alone may be insufficient for addressing this risk.

9.3.1 From mental models to social representations of GM food

The CMU approach assumes that risk perceptions are individual and factual. Yet the results show that the issues lay people are particularly concerned about are societal and representational. This is illustrated by Wagner and Kronberger (2001) who argue that rather than material coping focusing on the technical risks, lay participants cope symbolically by putting GM food into its wider societal context to try to understand what it all *means* for humanity and nature.

This shows the benefits of synthesising the CMU approach with SRT. By characterising representations as social, SRT indicates that they are symbolic and always influenced by culture, the wider social environment, memories and so on (Moscovici, 1984). Hence it is appreciated that GM food risk emerges socially and collectively, rather than scientifically and individually. When looking at GM food from a SRT viewpoint, it becomes clear that representations are more than a system of images inherited from culture. Rather they are the result of lay participants' confrontation with and coming to terms with the social object "GM food".

For example, there is no scientific link between BSE and GM food at all, but lay participants still make that link. Thus it can be argued that individuals do not make the judgement after reading scientific literature alone but rather through communication with others. Therefore GM food risk representations are social in part because they derive from ongoing interaction within society, within interpersonal communication, the mass media and societal institutions, rather than from individuals forming their thoughts in isolation and on the basis of scientific knowledge alone.

9.3.2 Moving beyond the information deficit model

The finding that individuals are not forming their thoughts on the basis of scientific knowledge alone presents a challenge for the CMU approach. The CMU approach is comparable to the information deficit model in that it assumes that problems in risk communication are solely due to a science-deficit in lay people. Consequently, the approach aims to provide the public with more facts as agreed by experts, with these facts tailored to the particular audience. It is still primarily a top-down approach because it seeks to bridge the expert-lay gap by bringing public opinion more in line with that of the experts.

But lay people have moral and ethical concerns that cannot be answered by science alone. Rather than a knowledge deficit, the problem is a moral/ethical deficit. Thus since the CMU approach discounts all the non-scientific issues which are of major importance for lay participants the approach by itself is insufficient to effectively communicate about the risks of GM foods. In agreement with Joffe (2003), the fact that GM is perceived as unnatural indicates that people's anxieties based on society's values are at least as important as cognitive strategies and errors in information processing for representing this risk.

Whilst the CMU approach can be criticised as a top-down approach regarding lay risk perceptions as (potentially) incorrect beliefs that need to be corrected, SRT does not define these perceptions as inherently faulty but instead regards them as socially correct in their own sense, because they are functional in everyday life. In this way, SRT changes the perspective on lay knowledge from "deviant" to legitimate risk representations.

Thus SRT offers an alternative to the information-deficit model by showing that rather than erroneous knowledge, lay participants' extra-scientific concerns express ways of understanding GM food. For example, participants' feelings of being conspired against and lied to do not have a scientific but rather a societal basis, emerging from past and present political, social and technological developments. These are concerns which no amount of scientific evidence could refute and which cannot be alleviated with the provision of more information alone as the CMU approach would suggest.

Accordingly scientists cannot by themselves be the driving force for a risk communication as it is essential to include other factors apart from the scientific risk in a communication. In order to communicate it also needs to be established what 'facts' are on the ground. Indeed, it seems impossible to communicate GM food risk effectively without understanding what constitutes risk for lay people. In this sense, as suggested by SRT it might be beneficial to first study lay people in order to understand the common sense knowledges of GM food. This would not only be valuable for lay people trying to get their concerns understood but equally, may be beneficial for scientific experts and policy makers because

“Ordinary people’s reactions to current environmental issues sometimes remind us of fundamental values or plain wisdom that can be forgotten in ‘sophisticated’ policy analysis.”

(Kempton et al, 1995; p.2)

9.3.3 Changing risk beliefs

The recognition that risk representations are social rather than individual phenomena presents a further challenge for the CMU approach because the approach aims to change individual beliefs. But reflecting on the controversial areas in expert and lay mental models of GM food, it is evident that individual beliefs are not the main obstacle to communicating about this risk. Rather, the issue is one of norms and values which are collectively shared and socially constituted. Hence the specific beliefs emerge out of the normative and value positions. In this way, representations of GM food are the outcome of group processes and legitimised as such.

In turn, this has implications for the stability and resistance to change of risk representations and for the way risk can be communicated. Because GM food risk representations reflect the cultural and social environment of which people are a part, it becomes clear why changing them is much harder to accomplish than changes in individual attitudes.

By recognising the social origins of risk representations, SRT gives a better understanding of the intersection between individual and group beliefs than the CMU approach alone and at the same time, potentially a better chance of devising ways of changing beliefs and attitudes. A necessary precursor to any intervention is to understand *why* the risk is represented in a particular way (Breakwell, 2001). Taking systematic account of the personal and cultural concerns of the target audience (Breakwell, 2001), SRT may provide this vital insight. For example, to develop risk communication interventions, it seems that one would need to address the socio-cultural bases of people's risk representations.

In this way, when compared to the CMU approach, SRT may offer a better direction for risk research as it can indicate where risk beliefs come from and how best to communicate and (if this is the aim of the risk communication) change them.

9.3.4 “Socialising” mental models of risk

To reflect back on our research framework, for the study of risk at least, it seems that it is not useful to adhere to one particular methodological approach single-handedly. Theories and methodologies are rarely “right” or “wrong” *per se*. Rather one has to look at how they fit in the particular context.

For the in depth exploration of expert and lay GM food risk representations, it is evident that SRT can offer a valuable addition to the CMU approach by contextualising risk perceptions and thus effectively “socialising” mental models. Rather than focusing on the perceived “deficiencies” of the lay public and viewing them as (cognitive) limitations of human nature, SRT takes a more holistic approach, highlighting the importance of the social context of risk beliefs.

Thus in the case of a societal risk such as GM food which is part of society's collective consciousness the framework can offer a different, bigger and more complete risk representation than mental models alone. Looking at lay representations as another construction of reality and from a perspective that recognises their sense-making value, their social, if not their scientific correctness is apparent.

In this regard, SRT provides a superior conceptualisation of beliefs and value systems to mental models. The CMU approach works well only as long as lay people are solely concerned about the scientific facts of a risk, and as long as experts can provide answers to those. Yet in the case of GM food, where facts are often still unclear, under investigation, and changeable, or when lay people raise questions about non-technical issues, the CMU approach alone is insufficient.

Accordingly, for the study of GM food risk at least, it is clearly beneficial, and even necessary, to move from the prevalent individualistic to more social approaches. By providing a sociological form of social psychology and moving away from the cognitive and individualistic biases of mental models, SRT helps to progress in this direction. Thus far, it is still a novel approach to risk communication, but the present thesis shows how this framework can be applied in practise.

9.4 Overview of findings: Part II

Regarding non-scientific risk dimensions, the first part of the research showed that one reason lay participants resist GM foods, is because they regard them as '*unnatural*', and as going '*against nature*'. Although previous studies (e.g. Sjoeborg, 2000; 2002; 2003) indicate that '*messing with nature*' is an important concept in explaining perceived risk, this issue had not yet been investigated in depth. The free associations task of the present study aimed to remedy this shortcoming, by looking at the ways in which nature and naturalness are constructed in relation to food.

Thus the objective of the second part was to establish what people mean when they say that GM food is unnatural and what frames of reference and anchors are used to make this judgement. This was done by putting GM food perceptions into the context

of other food- and nature-related 'objects'. 188 lay respondents completed an internet-administered free associations task. Using a split-ballot design respondents were asked to freely associate to the stimulus words food in general and GM food, or natural things and natural food. The resulting data was analysed with correspondence and cluster analysis. The findings are discussed in detail in Chapter Eight. Thus in the following section we focus on contextualising GM food representations by looking at the importance of the social significance of food, the contrast between the natural and the unnatural, and what nature actually means for people.

9.4.1 Food is a social concern

Associations to *'food in general'* evoked a broad range of activities, such as *'eating'*, *'cooking'*, and *'going to a restaurant'*. Also, food was often represented in terms of positive emotions, such as *'pleasure'* and *'love'*. Being associated with social events and culture, family and friends, as proposed by Rozin (1999) the social significance of food is evident and far outweighed its nutritional aspects. The results show that food is not just food. Rather, eating is a cultural activity that can be a source of pleasure as well as of concern. In line with Herzlich (1973) food is not solely a material but rather a social object because of what it signifies for human beings. This social significance associated with food may indeed make food risk communication particularly challenging, as it is a further issue that goes beyond the scientific dimensions of the risk.

Associations to GM food offer a stark contrast to all the other stimulus words. By and large GM food associations are rated more negatively. Few associations are connected to the socio-cultural symbolisms of eating. Essentially, GM food was simply not associated with eating and any of its broader meanings. Rather than food-related images, GM food representations were anchored in images of *'future'*, *'progress'*, and *'science'*, as well as *'government lies'* and *'capitalism'*. Couching GM food in scientific, social and political terms shows that these are social, rather than individual, representations, emerging through society and culture.

As in the first part of the research, respondents associated GM food with significant risks- to human health, the environment and third world exploitation. On the other hand, in contrast to the focus group participants, the results also showed that respon-

dents were often ambivalent towards GM food, perceiving both risks and benefits (such as *'helping the third world'*) of the technology.

Thus rather than being anti-science, participants were concerned with one particular technological application of science that is likely to influence society's food production and consumption processes. Maybe because food is a social object, science does not seem to have a place in the realm of food, which as the positive associations to *'natural food'* indicate is much preferred to be natural and pure.

9.4.2 The natural versus the unnatural

GM food characteristics visibly contrast with those of food in general and natural food. GM food was perceived as *'unhealthy'*, and *'unnatural'* in contrast to *'healthy'* and *'as nature intended'*. Strikingly, for all other stimulus words *'health'* is an important association signifying that health is natural, and that food in general is associated with being healthy. Also, *'eating'* is considered a *'natural thing'*. In this way, GM may stop this activity from being natural. The perceived unnaturalness of GM thus is a challenge to what people think food ought to be, contrasting with its natural state. Hence "the unnatural" is a characterisation of those situations, beliefs and actions that are other than normal in some negatively evaluated way. In this sense, "the unnatural" is counter to a framework of normative assumptions, i.e. beliefs and expectations of how things ought to be.

This implies that GM food is judged against a background of norms, values and assumptions about the nature of humans and their relationship with the environment. For instance, the naturalness of food is associated with harmonious relations between humanity and nature. On the other hand, the unnaturalness of GM food is the result of humanity "messing with nature" through the application of science. Thus judgements about the naturalness of food clearly are not simple assessments of the physical essence of food. Rather they are the result of evaluations of complex relations between individuals, society and nature.

Wagner et al (2001) suggests that positive evaluations of natural foods are not solely based on nutritional concerns, rather the more important aspects may be the ideologi-

cal and value conflicts it reflects. For example, the contrasting associations to natural food such as on the one hand 'McDonalds' and 'de-naturalised food' (rated very negatively) and on the other hand 'fair trade' and 'organic' (rated very positively) show that respondents make an ethical judgement against the unnaturalness of modern food production and consumption methods. Likewise, rather than reflecting health or environmental aspects, concerns about the unnaturalness of GM food may be more accurately seen as ways of expressing values, as GM food is associated with for example exploitation and capitalism. These are not material dimensions of the food *per se* but respondents associate these issues with GM food. In this sense, food is a moral and political issue symbolising of a broad range of societal concerns.

When compared to other foods it is evident that the dominant images of GM food represent attempts to construct a clear distinction between the natural and the unnatural. Saying that GM food is unnatural is an ethical judgement presenting a metaphor for saying that "GM is a harmful intervention". Despite its ambiguity, the concept of the natural vs. the unnatural provides a common socially constructed anchor for understanding GM food risk, with which participants drew the boundary between what is acceptable and unacceptable.

This drawing of boundaries provides a basis for separating the "good" from the "bad". Identifying the natural with the good is reassuring in our complex and uncertain world and simplifies the GM food issue, enabling people not to think about other issues. Contrasting GM foods to other foods by describing GM as 'unnatural' offered an unambiguous evaluation for participants, legitimising their judgement that GM is not right, and explaining why GM is not wanted. Rather than measurable scientific assessments, perceiving GM food as unnatural and contaminated are social representations of GM food.

Moreover, the lack of commonalities of associations to GM food and other stimulus words show that these constructs are perceived as contrasting realms. In effect there is a perceived dichotomy between technology (in our case GM) and nature. As suggested by Luhmann (1993), the technology here is viewed in terms of it being distinct from nature. Nature is what emerges and passes of its own accord. Technology is the making of an object or a state deviating from what nature would have brought forth

itself. Nature might fail to achieve its state of perfection if its normal course is disturbed, but a technology can exist- or not (Luhmann, 1993). In that way, for lay people it makes sense to resist the application of GM technology to our foods.

9.4.3 Affective and symbolic dimensions of nature

In contrast to most previous research which imposed researchers' definitions of nature, the free associations task allowed participants to construct their own definitions of the concept. This showed that there is much more to nature than its physical essence. Rather, associations highlighted the symbolic and affective dimensions of the concept. Thus from a psychological perspective, nature has to be viewed as being symbolically constituted rather than merely given, indicating that previous approaches to nature (such as those from environmental psychology) are insufficient to investigate what people really mean when they speak about *'messing with nature'*.

Frequent associations to natural things were states of nature, such as *'purity'* and *'harmony'*, as well activities such as *'eating'* and *'smiling'*, and words related to *'people'* and *'love'*, essentially all very positive images. Hence *'messing with nature'* goes against some fundamental values, against some fundamental part of people's belief systems. It is a partly social rather than purely physical concern that describes for example the destruction of harmony and the contamination of purity. Thus by moving from a positive to a negative condition *'messing with nature'* may signify danger.

Looking at values related to nature, with reference to the value-belief-norm model by Stern et al (1994; 1995) as outlined in Chapter Seven, it seems that egoistic, altruistic and biospheric values all play a role in GM food risk representations. When thinking about GM food people are concerned with the personal costs (e.g. that it is *'dangerous'* and *'unhealthy'*), with the costs to others (e.g. that it is a form of *'exploitation'*) as well as with the costs for all living things (e.g. the *'environmental risks'* and *'unknown long-term consequences'*). As suggested by Kortenkamp (2001), in the present results the separation between these environmental values is not unambiguous but rather a combination of all. Clearly, these issues need to be investigated in more depth, as how our relationship with nature is perceived is likely to influence how we

solve societal and environmental problems, and how to proceed with other novel technologies.

9.5 Conclusions Part II

In contrast to the focus group results of the first research stage, the findings of the free associations task show that lay participants, also associate GM food with significant benefits. Thus lay people's resistance to GM food is unlikely to be solely due to the lack of perceived benefits as suggested by Gaskell et al (2004). In turn, this leads to the question of whether there is something special about food risk that may not be shared by other risks. With the free associations results highlighting the social significance of food as well as the importance of the construction of naturalness in relation to food, it seems that as suggested in Chapter Two, food risk may indeed be a special issue for risk communication.

Reflecting back on constructions of nature and naturalness in relation to food it is evident that these are social representations as they are the emerging property of social interaction and communication. The social and affective dimensions which both food and nature symbolise are at least as important in structuring people's representations, as any physical attributes. Because food is a topic of great social significance, concerns about food are social issues that go far beyond its scientific-nutritional aspects. Rather than being anchored solely in nutrition, food is more often represented in terms of its social relations, and shown to be a concept laden with affect.

GM food was not represented in terms of socio-cultural factors related to eating. Rather than being represented as a food with all the social significance this entails, GM food was perceived as a scientific application. And because of that, it has no space in the realm of food, which is preferred to be *'as nature intended'* and *'straight from the farmer'*.

The representation of GM as unnatural is the result of social and societal norms and values rather than any scientific information. This implies that an in-depth understanding of the science of GM would not necessarily change lay participants' representations of the issue. Indeed, a better understanding of the scientific dimensions of

GM food would be insufficient to resolve the controversy as lay concerns about GM, food and nature cannot be easily put in scientific terms. Both food and nature are social and representational, rather than solely material, issues because of what they signify to respondents. Therefore, a constructivist approach, such as SRT, provides a useful challenge to the dichotomy between nature and society, by showing that (and how) lay people's understandings of food and nature are, at least in part, socially constituted.

Thus the present findings echo an important lesson for risk communication as proposed by Leiss and Powell (1997; p.220): "*There is always more to an issue than what science says*". Especially food is no ordinary commodity. Because it has a high status in culture as well as human nutrition it cannot be approached as a mixture of chemical compounds (Leiss et al, 1997). Lay people have more complex associations, such as about natural goodness and purity which cannot be adequately addressed from a traditional positivist framework. By ignoring these broader societal considerations, and implicitly denying their legitimacy, the communicators of GM may actually have amplified anxieties and mistrust (Leiss et al, 1997).

9.6 Limitations of the study and avenues for further research

Before looking at what these findings may imply for risk communication, we briefly outline some limitations of the present study which in turn open up avenues for further research.

Regarding representations of GM food, we do not make any claims that representations are captured completely. But completeness is not always necessary- as stated in Chapter Three we take a more pragmatic view, focusing on the purposes and functions of GM food representations for risk communication. We present particular representations of GM food risk at one particular point in time. It is appreciated that as representations differ from one culture to another at the same point in time and from one point in time to another within the same culture (Farr, 1993b) it is not possible to replicate a study of social representations because they are particular and not universal.

Looking back at the CMU approach to risk communication, the findings established that this approach does not work for GM food, but what about other technologies? Does the approach not work for value-laden technologies in general? Or does the CMU approach work for other technologies and not for food? The present research indicates that food may indeed be a special issue due to its social and moral significance. Clearly, there is the need to apply the CMU approach to other technological as well as food risks.

Regarding nature, as the present results established '*messing with nature*' as an important dimension in lay GM food risk representations, there is a need to investigate this concept in relation to other technologies. For example, is this risk dimension as relevant in relation to white or red (as opposed to green) biotechnologies? Is it a risk dimension that is unique to food or general to technological innovation? Different risks may elicit different moral dilemmas.

Finally, nature in general has been insufficiently researched empirically, not just in relation to risk perception. As nature cannot be seen in rational/objective terms alone, a purely psychological perspective is insufficient. However, as shown in Chapter Seven, empirical research that approaches "nature" from a constructivist perspective or that combines both positivist and constructivist stances is still rare. The present findings stress the need for a more social psychological approach to nature that can incorporate the symbolic and affective dimensions of the concept. Evidently, there is a need to further investigate these issues in order to move beyond the exploratory results of the present study.

9.7 Practical implications for risk communication

Despite these limitations we can tentatively suggest a range of further implications for risk communication. We reflect back on the risk debate within the overall frameworks positivism and constructivism, before looking at what the present findings may mean for risk evaluation and risk communication. Recognising the validity of lay risk perceptions of which non-technical dimensions such as values are an integral part implies

that these have to be incorporated in the risk assessment. But incorporating moral and ethical dimension in addition to the scientific aspects of the risk poses various challenges to risk evaluation, and in turn, risk communication.

9.7.1 How to evaluate risk?

The present findings established that risk is in part a social construct. As such, it can never be fully objective as the positivists suggest. Risk is difficult to communicate precisely because it is always to some extent socially constructed. GM food risk, rather than being a neutral product of science, is intimately connected with values, morals, ethics, societal power relations and the wider social, cultural and historical contexts. This means that the risk cannot be reduced to its scientific dimensions as a range of other aspects, many of which were highlighted by our lay participants, need to be included in its evaluation. Science alone cannot provide the answers to concerns over GM food as science cannot be the sole proprietor of moral reason.

In their chosen field of expertise, experts have, by definition, better knowledge than non-experts or novices. Yet they are not necessarily experts in other areas, and may even be inhibited to appreciate viewpoints not in line with their paradigm by being caught in the “prison of presupposition” (Markova, 1982). Most experts have only limited ability to appreciate the complexities that exist outside their own areas of expertise, while the real world is rarely sufficiently orderly to handle problems that stop within the boundaries of one’s own discipline (Freudenburg, 1992). Thus experts must acknowledge their own methodological assumptions, but as science is the defining paradigm of our age, this is often forgotten.

Science is not value-free, some active judgement is always involved, as expert disagreements in the present study indicate. Thus it is a simplification of the issue to accord experts with objective and the lay public with subjective risk perception as even expert assessments of GM food risk incorporate an interpretative element. GM food is not just an objective or a subjective risk but a combination of the two. At least in relation to GM food risk, the objective and the scientific or the subjective and the moral can hardly be divided as both dimensions make up the representation of the risk.

9.7.2 Non-scientific dimensions in risk evaluation and communication

Thus rather than attempting to separate the subjective from the objective, it needs to be questioned how the “subjective” can be usefully included to improve communications. Taking lay perceptions and their divergent non-scientific reasonings seriously raises the difficult question of how to address what are effectively differences in moral reasoning between expert and lay people. Clearly, risk communication and conflict resolution are likely to be particularly challenging if stakeholders are speaking from different moral perspectives (Slovic and Peters, 1998). In these cases, scientific risk communications are only part of the solution for conflicts as a clearer understanding of the “facts” is unlikely to resolve the underlying value disagreements.

Hence it is becoming increasingly clear that the deliberation of science-based issues and the formulation of policy can no longer be based on purely positivist risk assessments. The public controversy surrounding GM food has shown that it is no longer possible to leave a societal risk solely in the exclusive realm of experts and politicians. Public resistance has led to the recognition that the increasing pace of scientific development brings advances that raise novel complex social and ethical questions, which cannot be answered by science alone. Consequently it is vital to clarify how these subjective dimensions should be incorporated in a risk evaluation as the current uncertainties in risk assessment may also lead to uncertainty in policy making and vice versa.

Yet although the importance of including various dimensions apart from the scientific risk is evident, it is still unclear how ethical and moral dimensions should be incorporated in a risk communication, and what significance should be attached to these dimensions. Current research indicates that the public desires to include other factors apart from the scientific facts in policy making. While around 50% of the publics in Canada, the US and Europe prefer to see science policy made on the basis of scientific expertise and on the grounds of a scientific assessment of the risks and benefits, the other half of these publics want to see either more public engagement and/or the privileging of ethical and moral issues in decision taking (Gaskell et al, 2005). Thus there is a clear need to consider the ethical, legal and social implications of technological innovation in addition to the science *per se*.

9.7.3 Accommodating alternative rationalities

Our findings showed that the questions the public wants answered are often not technically about risk, but rather about non-scientific issues such as about values, trust as well as political and social control, and power relations in a democracy. And in a democracy, the public has the right of having their concerns taken seriously.

Thus in the case of societal risks involving moral and ethical concerns wider stakeholder inclusion is necessary to understand the social sides of technological innovation. As suggested by Funtowicz et al (1990) this democratisation of science may need to have extended peer communities and extended facts. This further democratisation of science inevitably leads to challenges of public participation, where to date many unanswered questions remain. It is questionable how democratic risk communication is today and how democratic it should be as a more participatory model has a range of likely problems.

Looking back at Fischhoff's (1995) historical stages in risk communication, we are reaching the 7th stage- *'all we have to do is make them partners'*. The question that arises is whether we are or should be equal partners, i.e. are all risk perceptions equally valid? It is still unclear how this partnership should evolve, to what extent expertise should be democratised and what role the public should play with regards to risk management. Should the democratisation of science follow the democratisation of the political system? A foremost problem is the tension between the need to rely on expert facts and the need to incorporate public values and preferences.

In essence, the major challenge is how to accommodate and integrate alternative forms of rationality. Many questions remain unanswered. For example, what weight should be attached to various stakeholders' opinions, especially if these are without formal qualifications on the subject matter? Although this would bring about a democratisation of science, and bring science in the public debate, would this new form of practice still be science as we know it? At what stage of technological development should a risk communication take place, who are the interested parties, how and where should communications take place? Importantly, how are results implemented

into policy making? Also, as the public is not a homogenous group, could one communication work for all?³⁷

At present, participative two-way dialogue is still in its infancy stage, and it remains to be seen how it will be developed and applied. It has to be established who the new participants are, how interactions should be managed and evaluated and importantly how non-scientific conflicts, such as those about values, should be resolved. Although increased public participation and the inclusion of alternative rationalities has the drawback of making risk management far more cumbersome, on the other hand, it could ensure that conflicts are resolved earlier on, making it cost-effective, especially when aiming to introduce an expensive new high technology. Commenting on the public controversy over GM, Bruce (2005) contends that:

“If nanotechnology is to avoid a similar waste of investment, we must find better ways of incorporating basic values and seeing where there are synergies with society and disjunctions.”

(Bruce, 2005; p.21)

9.8 Concluding remarks

In conclusion, the present thesis established how different people make sense of a particular new technology, namely the genetic modification of foods, and showed that lay perceptions can be viewed as rational in their social-cultural contexts. Regarding lay perceptions as justified implies that they have to be taken seriously. In turn, taking lay views seriously means that it is impossible to avoid confronting the issues as they are posed in society, not only how they appear in science-based risk assessments. Thus in the words of Leiss et al (1997; p.223) one important lesson for risk communication is that: *“risk messages should address directly the ‘contest of opinion’ in society”*.

³⁷ At present, various research projects of the 6th framework programme aim to address a range of thematic areas within the science and society realm. For instance, the PATH (Participatory Approaches in Science and Technology, executed from 2004-2007) project investigates how to best represent a diverse and diffuse public as well as ‘silent voices’ (such as those of future generations).

As the GM food controversy has shown that public resistance can hinder the introduction of a new technology it is evident that new ways of risk assessment and risk communication have to be found. There is a clear need for some democratisation of science involving more and better public consultations. In light of the potential introductions of other new high technologies which can be very costly public opinion has to be gauged before investing, and public fears have to be understood, in order to shape the trajectory of the technology in a more acceptable way.

Today, risk communication strategies are undergoing many changes, and in relation to the ever evolving societal risks, will likely continue to do so. Risk perception has come a long way since the public were simply described as “irrational”. The long prevalent information-deficit model has become discredited as it is understood that solely providing scientific information is insufficient to alleviate lay concerns. Rather, it is now acknowledged that communication needs to be a two-way process incorporating lay views that may not be in line with orthodox science. The difficulty is how to proceed when scientific rationality which has been the dominant marker for decision making in the past century is questioned from a moral or ethical perspective for which traditional science does not have the answers. Although there are still competing paradigms, boundaries seem to be blurring with the recognition that risk is at least partially a social construct. Clearly, although positivist science cannot simply be replaced as the dominant paradigm, it needs to be complemented. Regarding GM food risk at least, the technical, rational understanding of truth and knowledge needs to be supplemented with social, cultural, moral and ethical dimensions to provide a more complete representation of the risk.

APPENDIX A: EXPERT INTERVIEW TOPIC GUIDE

Expert interview topic guide

This interview is divided into two parts. First, I would like to ask you about the current and potential developments related to GM foods in general. Second, I would like to ask you some more specific questions about particular issues.

Current developments

- What are the current developments in relation to GM foods?
- What do you regard as the most important developments?
- What are the potential developments?
- What do we know about the risks and benefits for the consumer?
- What do we know about the risks and benefits for the environment?
 - How certain are you about ...?
 - What are the areas of uncertainty?
- What, if any, issues are you personally concerned about?

Particular foods

- How far advanced are future developments, such as particular pharmafoods?
 - What are their risks and benefits?
- The research by Dr. Pusztai's research indicated that GE potatoes harmed rats. What do you think about these findings?
- Do you see any problems related to specific GM foods, such as GE salmon?

Allergenic potential of GM foods

- Is there the potential for consumers to develop new food allergies (or any other illnesses) in relation to GM foods?
 - In which ways could the genetic modification of foods enhance allergenic potential?
- How much (if at all) more research is required to facilitate better risk assessments?

Genetic interactions

- Do you think that organisms produced using GM techniques may have unexpected novel properties in addition to those which are being deliberately introduced?
 - What, if any, is the evidence that unexpected effects can arise from the use of GM techniques?
 - Can these unexpected effects be adequately addressed by the current regulatory system for foods produced from or containing GMOs?

Food safety/regulation

- Is the current regulation in place sufficient to ensure the safety of GM foods?
- What is your perspective on the use of substantial equivalence a basis for GM food risk assessment?
- How are GM foods labelled at the moment?
 - What is your opinion on the labelling of GM foods?

Is there anything else you would like to add?

Thank you very much for your interview.

APPENDIX B: FOCUS GROUP TOPIC GUIDE

Focus group topic guide

This focus group is part of my PhD research on risk perception of GM foods. I'm interested in how you think about these issues. Don't worry about whether your ideas are right or wrong. I'm interested in everything you think about this and want you to say everything you think relevant to these issues. We're beginning with some very general questions, before I move on to some specifics.

Introduction

- When I bring up the word GM foods, what kinds of thought does this bring to your mind?
- What is your opinion on GM foods?
- What are your hopes and concerns in relation to GM foods?

Basic prompts:

Anything else?

Can you tell me more?

Don't worry about whether it's right, just tell me what comes to mind.

Can you explain why?

Who else has some thoughts about this?

You've been discussing several different ideas- what haven't we heard yet?

Risks of GM food

- What have you heard about GM food risks, for yourself, for others, for the environment?
- How significant a risk are GM foods in your opinion?
- Do you think GM food poses risks for public health?
- Do you think GM food poses environmental risks?
 - Do you think the introduction of GM crops might have an impact on biodiversity?

Benefits of GM food

- What do you know about the benefits of GM foods, for yourself, for others, for the environment?
 - What do you think about potential benefits, e.g. nutritional, financial?
- Through GM scientists are trying to develop draught resistant crops. This would for example make it possible to grow these crops in very dry climates. What is your view on such issues?
- Do you think GM crops might be beneficial for the environment?
 - Have you heard of the development of herbicide tolerant and insecticide resistant crops, what are your views on...?

Risk assessment and management

- What do you know about the UK regulatory procedures with regards to GM foods?
- What areas are you uncertain about? What kind of information would you like to have?

Is there anything you would like to add which hasn't been addressed?

Thank you very much for your participation.

APPENDIX C: ALCESTE REPRESENTATIVE ECUs

Elite interviews: Representative ECUs

Clé sélectionnée: (A) Regulation

380 56 what processes have been #involved in the #production of #foods not #simply what are the final #ingredients. the #label is not #compulsory; it_s voluntary in most cases. where they #derive from maize and #soya, #currently in #europe you do have to #label. but you only #label when there is #detectable dna from the #gm #origins.

443 42 you can think of #gm_products or #products #derived #using #gm_technology that would be advantageous in #terms of #lower #processing #costs, and subject to the economics of the #food #chain that might be passed on to the #consumer in #significant measure.

356 35 but there have been #gm_foods on the #market, including #gm_ingredients, #therefore #gm_foods, and there are at the moment. DAB: anything that #contains maize and #soya #derivatives and flour or #oils which is used #extensively in #food #processing.

266 33 then of #course people always #argue that #usa has not had any of the sort of #food #scares, such as #bse, #foot_and_mouth, and #others. and #therefore there is just a more #positive #acceptance in the #usa. well, it #slightly #depends on what you mean with #gm_foods.

358 33 but from a #consumer_s #point of #view they are concerned not only about the #composition but about the #origins of the #gm_ingredients. the result of this is being that #retailers, at least in the #uk, have sought non_gm_sourcess of maize and #soya from which to get their #derivatives to go into their #processed #foods.

448 31 so that would be a #similar example. my #view is that the #analysis of risk should emphasise the #nature of the #product rather than the #process. secondly, what is the #comparative for #relative risk? and it #seems to me the most logical #comparator would be #equivalent #products generated by #conventional #breeding.

444 28 well, the #usa, and I believe canadian agencies as well, emphasise the #nature of the #product not the #process by which it is generated. and #therefore if a #product can be shown to be identical in #respect of not being distinguishable #relative to the #comparative #product from a #non_gm #breeding programme, then there is no #requirement to #label as such.

360 26 and that_s why a lot of #processed #foods will #say no #gm_ingredients or no gmo, because they feel under their sourcing they can #provide that. although that #depends on the adequacy of the #testing. well, you have to #define then what a #gm_food is. because I have not even #included.

274 25 and as soon as it became #clear that a #significant #proportion of people did not #want them and were very very vocal in opposition to them on #simple grounds, it was #fairly #obvious that the #retailers and #manufacturers were loosing the battle.

350 25 the ending of #substantial_equivalence as a baseline for whether or not to review a #novel #food, which has been #gm, is in the #current #eu legislation, which is being passed as we speak.

447 22 the most #obvious one here is #food #irradiation. if you look at the #product, you might come to one #set of conclusions in #terms of public #acceptance, if the focus is on the #process it turns out in #terms of public #acceptance, the public does not want it.

462 22 where I do think it becomes a problem is where you have this issue that there is no #simple dipstick #test at the #point of

purchase for the #consumer or the #food #retailer to #say whether something is #indeed #gm or not.

268 19 equally then there are various #products, which #contain the #oil of #gm_products so you can quite legally #sell #foods #containing #gm_soya and so on. but of #course what happened is that all the #larger #retailers have done their utmost to try and ensure that they do not #sell such #products.

348 19 well, #currently with #gm_foods there is #european legislation, which is recasting for the #foods the final #food #products the #basis under which they are #tested. previously this assessment had been #based on #substantial_equivalence, those #equivalent to non_gm_food #equivalents.

434 19 the problem with that is then of #course that from a regulatory perspective the only way that you can ascertain whether a #canola #oil is #derived from a #gm #bred #canola plant or not there is no #simple dipstick in the #supermarket to #test it.

446 19 and where you have a #processed #product like #sunflower #oil or a #canola #oil, there is no #simple dipstick #test. and that then creates a regulatory issue and there is some disagreement between the #uk #government, perhaps one or two #others, and the #eu right now.

362 18 so there is #extensive pervasion of #gm_ingredients, not just in #terms of the #food #product but also #terms of the actual #processing agents. #gm_foods do exist it_s just a question of how one #wants to #define it. not much. they are #novel, they are new, there have been no clinical trial undertaken, no large samples taken, no #control #groups so we do not know anything.

133 17 well, before this skilful #campaign was #exercised, there was a #gm_product that was on sale in the #uk in #safeway #shops and in #sainsbury #shops. and it was small cans of #tomato_puree, prominently #labelled _made with gm_tomatoes_. and it was on sale for three years, alongside #conventional cans of #tomato_puree.

182 17 #food #products. and #therefore they #say in their #press release, this gives the #possibility of #manufacturers avoiding having to #say _may #contain #peanuts_. does it? think about it. does it leave that #possibility? RB: but now they #say _we can #test to show that there isn_t any peanut there_.

Clé sélectionnée: (B) Risk

66 70 and that_s #somewhere #else in the #body but there is no #evidence at all that they are #put #into the #gene #material. if they were, you know you and I after #eating #potatoes for 400 years, might expect to #find #potato #genes in our #guts.

455 35 now the #question then becomes, is there, because of the #potential to #put in a #gene from a #different #species #into a crop, does that #create any special #hazard?

202 34 #you_ve #inserted one #gene in a particular #place. or maybe two, but one is the typical thing. #actually, with the golden_rice it_s three or four, but never mind. you_re splitting specific #genes and #putting them #into specific #places in the #dna. so you_re #targeting very precisely.

577 34 but the #question is how much research do you need to do before you make a #decision? and that_s a political #question, that_s not a science #question. the other point I_d like to make is that if #you_d #actually want to do some of these #experiments which are very important in #risk #assessment say for example #you_d want to #assess how #gene #transfer from a crop to a #wild #plant would #affect the/

702 34 and of course the #green_party and all those groups jumped on that. but every test that was done subsequently has #shown that there were no allergies #related to starlink. always when you_re #in-

serting a new #protein #into a #plant #you've got to ask the #question is there the #potential for an allergic response.

179 31 we can never evade all #risk #completely. we can #take #precautions but. so the #precautionary principle is really the other side of the coin of #risk #assessment. in other #words, we #assess the #risk, we #identify the #hazards that could lead to that #risk, we address them and try and solve them, try to #put in #measures that will prevent or #minimise them #happening, and it's only when you have real,

510 31 it may be #dangerous with some #proteins. yes, I'll give you an example of that. there's a lot of interest in #putting #lecithin #genes which are #toxic #into #potatoes for example, to #protect the #potato against insect attack.

505 28 it's crazy when people say _oh, these new #dna #sequences or #proteins are going to pose a #danger_. it is #actually #highly #unlikely. there are very few #proteins that are #toxic to human beings, there are some, but they are mostly in crops that we do not #eat, or in #plants that we do not #eat.

65 24 but they are being #phased #out. now those have been added but you can #actually #track them quite carefully, you #heard #john heritage_s talk about his work. there is quite a lot of other work where people have traced radioactive labelled #genes through the #gut. well you can certainly #find bits of the #protein, and you #find bits are transported through the #gut wall, and you can #find them also in the #body.

69 23 and one particular one had been #introduced #into this #corn, and when they modelled it in three dimensions, they thought there might be an allergen present. as far as I'm #aware there is no #actual laboratory #evidence that it is an allergen, it is purely on the basis of #computer modelling.

215 23 and the #technique was to include an #antibiotic #marker, you see, so that the #plants which had #taken, which were going to be successful, were resistant to the #organisms that were #affected by this #antibiotic, and the others that weren't resistant,

113 20 but it's all dynamic. your #risk #assessment needs to be constantly updated and revised in the light of new knowledge, your #risk #communication is both before and after #decisions on #risk #management, and it's still ongoing.

218 20 I'm not #aware of any problems of just ordinary gm_foods #affecting people_s #genes or so. this was a set of #experiments to #assess the possible #value of #lecithin for gm.

512 20 so there are #dangers in #putting these #toxic #sequences #into food #plants because they might get #into the human food chain, even though they are destined for industrial #purposes.

572 20 and he #put the pollen on the food #plant and he #found that the larva died. now there was a huge amount of publicity about that. poor #john was besieged in his lab for weeks by the #media. but all he had done was he #found a #hazard, a #potential #hazard, but it was no more than a #potential #hazard.

580 20 but they only/ just #managed to get permission to do that in the usa, and they had to #put in a huge #number/ of #safety #measures to #carry #out those #experiments.

456 18 my argument would be that relative to the creation to new cultivars by wide crossing such as making #rice with a #wild #variety or even a #wild #species of #rice, where you're #actually not #introduce one novel #gene, but mixing 50.

578 18 fix? of that #wild #plant in europe you could not do those #experiments because the #regulatory #system would not allow you to deliberately #put a trans #gene #into a #wild #plant and then #put it #out and see how it behaves.

201 17 right. that_s the analogy I_m going to use. what they do in gm is to #cut a #gene #out of the #dna of #somewhere, something. and then that_s if you like the donor. then you go to the host #dna and you #cut and copy and paste what you #cut from the other one #into that #dna.

Clé sélectionnée: (C) PUS

85 21 that is rice enriched with pro #vitamin_A, which would #play a tremendous #part in preventing blindness in #children in southeast_asia. but there is #work going on, and this is with #micro #nutrients. A lot of the #problems with #world hunger. it_s not just quantity, it_s #quality and #particularly the lack of #micro #nutrients like #vitamins.

154 21 now they were beaten. perhaps because they did not have the #internet in those days, I do not #know. but I #think that has #played a very #big #part.

171 19 the 8th of april is tuesday. so you see, we made a #mistake. #mistakes can happen. I #know #acnfp #pretty #well, I #know some of the #people who are on it, and I #think they do a thorough and effective #job.

651 19 both #to #give supplements and #to #increase much more mixed #diets #to fortify. so this isn_t a #problem that we do not #know how #to #solve very easily. I do not #know maybe golden_rice might #help. but if you #really wanted #to #improve #diet #people who have #vitamin_A #deficiency also #usually suffer from a range of other #micro #nutrient #deficiencies.

306 17 we #ought #to be #try #to #address both in terms of medicines and #food_production the #world_s #really #big #health #issues. and #private #companies, I certainly do not blame them, that_s not their #role, they can not #really.

752 17 I mean #george is one of my #favourite #social #scientists, #george is very #objective and serious about it and isn_t involved in confusing campaigning with #social #science. anything you could do #to #challenge that and make #sure they are being more #objective would I #think #help. I wonder whether that_s because #george is not #part of their mafia.

91 15 not #true! what happened was, as #part of the, this was being done in conjunction with the #scientists at the #university of nebraska which is the research center which #knows more about #allergens than #anybody else I #know the #people.

314 15 #well in the uk I have been #extremely #impressed at the way the #fsa has gone. I mean, I #think it has done #extremely #well. #nothing in life is #absolutely foolproof, but I happen #to have quite a lot of confidence in the #fsa. I do not #think in this #country we have a civil service such as defra, who are very #quick #to #learn the lessons of previous food #problems.

169 14 I #think he is blind and selfish and a #politician. RB: #well, the one I #spoke about was not a #committee, it was a research department which specialises in #allergy and they were #scientists doing tests.

191 14 but I #think there is no reason that I #know of no #factual reason why #gm_crops should not be grown in the uk. RB: #well, this again is a #myth.

700 14 the #big #issue could be about #allergies if #people do not test #things #sufficiently. but again I #think there are tests #around now #to #check this out and it has #to be done on a #case by #case basis.

279 12 #well, as you #know although I was #originally a #scientist, I now #work in the #social #sciences, and in the moral #philosophies, and I rather like #arguments about what is #necessary.

304 12 #well there are lots of #issues. I mean, my own view is that we have got the position now in the #world where short_term #to medium term #commercial interests in #food_production are far more #important than #long_term #considerations,

714 12 so we just have some soundbites. I have great #arguments with robin grove white, he accused me at the #last #meeting of being arrogant. I_ll #send him a letter saying _you might #think I_m arrogant but I #think the way you_re deciding #things for other #people is the height of arrogance.

67 11 so we are back #to a #public #perception #issue in which #people #think that gm genes will behave differently in kind from ordinary genes. and there is #absolutely no evidence for that at all. DB: oh #well, there was no evidence that it was going #to be #allergen even for #animals.

88 11 then there is #work on removing we hear a lot about the possibility of #new proteins in gm #possibly being #allergen. now that_s #possible and there is a #famous #case where it was in #fact discovered as #part of the routine of #checking these #things.

136 11 they had a very #complex network of listings on the #internet, which #somebody tipped me off about. and I watched how this was being plotted. it started in january 1999 and by may it had done its #job. it still #continued but it had #really done its #job by then. the whole of the #public #perception had being turned #right #around.

153 11 #well of course! but the #argument is. _not now but sometime in the future_ is an #argument for' never, isn_t it? we never #know everything about anything. the same #argument was used in the first two #decades of the #last #century by the #people who #try #to prevent the legalisation of milk pasteurisation we do not #know the #long_term effects, it might be harmful, and so on.

190 11 oh, #greenpeace is very #wealthy. #well, for the #existing foods. the #existing ones, #well, the field_trials are #partly #to #determine this, predominately #environmentally. #well I #think as I have said that the testing needs #to go on, #to #continue, #to be #improved and #monitored #to see what happens.

Clé sélectionnée: (D) Environment

536 49 it_s there all the time, but it_s not economically a #serious #pest in most cases there are only #small patches of it. but #herbicide #tolerance is the #main transformation that is #available, and #that_s the #main #type of #crop being #grown in the usa very #widely.

96 31 now #that_s another #way of doing it. and then there is #research #going on on gm_foods that can #grow in #conditions that have been inhospitable to those #crops. #crops that can #grow on #salty #soils, making a #whole #lot of #land #available without encroaching on the wild #environment. #crops that will #grow on aluminium #rich #soils, again making a lot of #arable #land #available that previously was not #arable #land.

534 30 those #crops are #widely #grown in the usa and there is a #small #amount of #bt #maize #that_s #grown in spain at the #moment on a commercial basis, but it_s only a very #small #amount.

533 25 so you can spray the #whole #field when the #crop is #growing with that particular #herbicide to kill the #weeds but the #crop itself is completely unharmed. the other #main #type of #crop that is being developed is #insect_resistant #crop using the #bt gene.

308 23 yes. the bit in me that is also rather keen on #biodiversity is a #little bit #worried about that. not so much the #salty bit, quite a lot of #arable #land has #become to #salty because of the #way the #crops have been #grown, so it would be quite useful to be #able to reclaim those #lands for #arable production.

540 22 whether #farmers would do that we do not know. my intuition tells me that they would not, they would #use the #trait to its maximum #ability. but we'll have a bit more information of that later on in the #year when the #farm #scale evaluation #trials #results will be published in september, 2003.

546 22 it's also #relevant to the #way in which our own #climate is #changing where #crop growth is being #reduced often now because we have certain #years with very #long #drought periods.

437 21 #primarily at/ the #moment they are related to #pest #resistance, #bt, and #secondly, #herbicide #tolerance. and/ then there are other #whole #series of products at some stage in the pipeline potentially/ #available, which you might #call output #traits, that is food quality, nutritional value and so/ on.

555 21 the answer to that/ is that first of all they can #charge royalties on the #hybrid, so they will #charge #farmers for/ saving those #seeds every #year, and #that's easy #money for them.

561 21 you'd still need to put phosphates #onto the #fields #form time to time, but you do not have to put #nitrogen #onto the #fields. and that would have #enormous #benefits for #farming profits, as you would not have to put so many #inputs into the #farm in order to make #money.

640 21 #under the current #conditions of #what's #under #offer and taking into account the alternatives that are #available. because it's not #herbicide #tolerant #crops or carry on as we are at the #moment that isn't the choice that we face.

673 19 A #lot of it is described on the horizon scanning report of the aebc. clearly #there's #stuff #going on now such as #herbicide #resistant #crops, #insect #resistance, #fungal #resistance, virus #resistance, #drought #tolerance.

725 19 there've been a #whole number of #studies done about the #separation #distances between gm and non_gm_crops and all of the #industry is now saying that if it is #agreeable that #cross #pollination would be acceptable for the #organic #industry at say 0.9percent,

474 18 so for #example, the #bt #cotton and some of the other #bt #crops there is now some very clear evidence to demonstrate that what was #predicted is happening and that is that the #crops can #grow with #reduced #pesticide #inputs that has major #benefits in terms of the/

573 18 what followed after that was a #whole #series of #studies which took three #years to complete where an #enormous number of #researchers #went out into the #field and they looked at #pollen that was actually coming from #bt #maize that was #grown in the/

674 18 and then #stuff #that's being worked on for #industrial #crops, pharmaceuticals, and quality #traits, like the control of ripening, the control of colour, the control of taste, #changing the colour of #flowers, lengthening shelf life.

7 17 now #that's the reason that US #farmers have #gone that #way and also in #south america. the other big development is the #insect_resistant varieties of #maize, #mainly, and #cotton.

75 17 just one or two #applications at the most of a single #herbicide which is more readily broken down in the #soil, is less persistent and less toxic. and so #that's a #benefit. it also #means that the #farmer does #not have to #use tilage which in turn minimises #soil erosion.

726 17 then it's manageable within sensible #distances of say twenty0 metres. the #organic #movement are basically saying we want 0.1percent not 0.9percent, and they're only saying 0.1percent because #that's within the #limits of measurement. the only #crop where it's #serious is #oilseed #rape.

Focus groups: Representative ECUs

Clé sélectionnée: (A) Industry

459 26 V: but it would still be a #third_world #country, it wouldn't change that much. if they #wanted #to do it, they would have done it already. P: also, there are other #ways of #helping the #poor, they could do it in another, #better #way.

648 21 C_mon! P: in the #end, they #want #to #make the #poor #dependent of their products, their #seeds, their #crops, so they can #make more #money. I #think saying _oh we will #help the #poor_ is just an excuse so that #people #accept all that stuff S: and even the #poor #countries are rejecting gm there must be a #reason for it!

563 20 D: #that_s just this #argument the #companies use #to #make their products more #accepted! #there_s not a grain of truth in that. if they #wanted #to #feed the #poor, they could do it #easily without gm! just #give them some of the #money that is being used for research at the moment and they could happily grow their own foods!

663 20 if #countries #wanted #to #help they could, say #spend less #money on the military, on #wars and so on, and #invest the #money elsewhere. until they do that, I have no #reason #to believe that they really #care about the #poor #people.

741 20 I #think they_re #producing it for a #reason, and that #reason is not #to #help the #poor. maybe it will #benefit the #poor as well, but #that_s not the aim behind it I #think SG: #that_s just a #selling technique S: they wouldn't bother #spending all this #money on research, on persuading the public, etc.

161 18 all the #money #that_s being #invested, I #think #that_s a #way #to avoid #thinking more #seriously about the #way that we allocate #resources. it_s another #way of shortcutting a-lot-of very #serious and #deep problems.

622 18 EF: but there are other #ways #to #help the #poor. for example, the #amount of #money .that is #spend in the #usa on pet food every year is .

208 17 and I do not #think #that_s going #to change. J: but how can you unpick that? MI: you can not there are always lots of #people who #want #to #make #money, #everyone #wants #to get richer, we #live in a #society where #everyone #wants everything now and all the time.

624 17 6 #billion. so with the #amount of excess #money of the #usa on pet food alone, not #to mention #make up, etc. you could #feed #everyone #easily! it_s not a #matter of inventing a new food, a new technology and all this #nonsense! it_s basically a lie saying _oh we do it for the #poor #people, for their health and all #that_.

742 17 if they wouldn't potentially gain a lot from it A: I mean, have you ever heard of #companies #investing #money solely #to #help the #poor or the #environment? #that_s #nonsense, I just do not #think it happens. T: #there_s enough food in the #world #to #feed #everyone, we have so many surpluses already.

623 15 10 #billion, and the #amount #you_d need #to #feed #everyone is

653 15 DE: but it might #help, although we do not know that yet for sure T: if they could #guarantee that it would #help #poor #people in the #long_term, then yes, that would be a #benefit S:

309 14 they are always saying _oh we can #feed the #world_ but you have #to remember that the #companies who are doing this gm are not charities. they do not #care about #feeding the #world, they #care about #making #money. and this #argument. I feel they are #using it #to #make us feel guilty, I #think #that_s despicable.

659 14 EF: yes, aids is a good example actually. the #companies have well not a cure #exactly but something #to #make #people with

aids #live #better and longer #lives and what do they do? do they #want #to #help, do they actually #supply them with the medicine?

162 13 #instead of #thinking how can we distribute the food #better, how can we #make it #available #to those who need it most, how can we #help the #poor #countries grow their own food, what #long_term #solutions are there?

165 13 it_s all done for #profit, I do not #think they really #care about the #third_world. otherwise they could have done something there with all the #money they_re #investing in gm_food! G: yes, this #feeding the #world is #nonsense.

610 13 EF: it_s a nice #idea, but the problem is that the #usa #companies who #produce the gm food have the #patents on the techniques T: and they do not #give them #to other #people EF:

660 13 no, because they can not pay for them! #that_s absurd, these #companies have so much #money, they could afford #to #help if they really #wanted #to, but all they #care about is #profit.

209 12 and the #world is overpopulated as it is. too many #people #wanting too much #money. MI: not for all #people on this earth. A: this is not going #to work, at least not in the #long_term.

Clé sélectionnée: (B) Food

105 56 you know when I go to a #tesco #supermarket and I #look at the #ingredients and I tend to do that a lot it #reads like a chemist_s prescription as opposed to a #food store because it has #loads of #additives of all #sorts of kinds.

492 43 you #buy tinned spagetti, you can be sure they #contain gm! V: I have one question: spagetti is not made from #soya #bean is it? S: not yet! MW: but #generally #processed #foods do #contain gm.

509 38 DI: if it was the same #price would you #buy it? C: then I would #buy only #organic. P: me too. #I think all #gm_foods #should be #labelled at least #ALL: yes, #definitely D: I want to have the #choice!

218 36 I_ve just started to #check out every #label, and I feel you should not have to do that just because you want to cook a #meal. when you #buy your #foods, your vegetables, your #grains, and so on, you should not have to be #looking at every #label to see whether it has these #additives or gm in it.

221 30 so now you_re not #looking at your basic needs anymore, you have to process all this technical information, to be #honest I_d #prefer if it wasn_t like this. it_s very complex with a lot of layers going on now. D: and I #try to #buy #organic whenever I can but it_s very #expensive.

507 30 often it_s twice as #expensive than other #foods! N: yes, if I could #afford it I would only #buy #organic, but I_m a student. V: the taste of #organic #food is just better, that_s it. D: yes, the taste is much better and also you know where the #food comes from, how it_s been #produced.

290 26 MG: you can not see it even if it_s a raw #product, and less so in a final #processed #product. RB: but they say it is #labelled MG: I_ve never seen a #label SB: I_ve always just #assumed that it actually is not happening yet, that it_s not commercialised yet RB: some #supermarkets have signs like _this is not gm_.

602 26 T: it_s all done to cut the #costs of food_production, isn_t it? I do not trust their #motivation at all. I #prefer the natural #foods. I would like to only #buy #organic #food but they #costs twice as much!

510 23 C: exactly, I want to decide myself what to #buy and I can only do this if #foods are properly #labelled. P: I think after time I might #buy gm, too, first I would resist but then you get used to it I #guess, it may be #cheaper, and I do not really #read any #ingredients, I_m too lazy for that.

603 22 S: yes, #organic #food is too #expensive T: and you know why? it_s so that only few people can #afford it and so that the #rest all have to #buy gm!

511 21 I do not #read what is says on the #packets. DI: I would #prefer to have the #choice as #well. S: I do not think anybody really #reads the #labels in the #supermarkets! DI: I do! S: if you have time. MW: if you do #read it, you will be very surprised what_s in our #foods.

94 19 and if you were to #label #gm_tomato in a #supermarket I_m sure that #nobody would want to #buy them. I think they were trying to sneak them in #processed #foods, and they_re #probably doing that right at the moment.

247 19 J: it_s like it was with #bse. G: it_s like the marie antoinette concept of if there is no bread let_s feed them brioche. MI: #well, she said that but she did not have enough brioche for all of the people! G: yes I am. J: yes, I always #look at the #label, and when I #buy some #chocolate it seems to have all #sorts of things in it, like #additives, gm.

333 19 so #therefore I would not want #gm_foods on the #supermarket #shelves, unless they can be declared safe. SB: from an economist_s point of #view, if the #gm_food is #cheaper than normally #produced #food, you can be absolutely certain that we are all eating it already I:

491 19 V: do you think so? I think we do but we do not know about it. MW: #well, so many #products here #contain #soya and this is #generally gm #soya, so I #assume we are actually eating a lot of gm.

155 17 D: but say with the #gm_food that #nobody wants are we going to feed that to the poor? the #rich can eat #organic #food, and the poor have to eat gm, which is #produced by the #rich and which makes them even #richer at their #cost!

588 17 now is the time when we can still #choose but I think we won_t be #able to do that for much longer. ok, maybe we would still have some #organic but it would be too #expensive and most people just couldn_t #choose to #buy it, they would have to #buy gm.

576 15 T: completely tasteless. EF: also, gm are often not as nutritious as real #food. S: what are the #guidelines for #gm_food, I have no idea. DE: if a #product had less than 0. 9percent of gm_ingredient it doesn_t need to be #labelled here in the #uk, in the usa it_s different.

844 15 C: I_d #buy #gm_foods because I_ve got no #choice SG: I do not bother to #look A: I do not necessarily think #gm_foods are more dangerous than non_gm_foods but I do not like these #associations.

Clé sélectionnée: (C) Nature

352 34 for #example, #putting a #completely #foreign #gene, say from some #animal #into an #apple I find #totally unacceptable, for the reason that it is #unnatural beyond belief it #simply could not #happen if #nature had her way.

451 25 and in the end we have super insects, super weeds. V: how #dangerous is it for the #fields, the grounds, will it #change the #soil content? organic #farming is #different and much better than #artificial, #modified #farming MW: I #mean the #fertilisers will be washed down in the #ground and get #into the #ground #water, and the more we have of them the #worse it will be for our #health.

45 24 I just do not like that. it_s #artificial to #put these things #into our #animals, but that_s #different from #gm. MI: it_s #different but both are #unnatural. #milking a #cow 24 hours a #day, their tits #start to #grow bacteria on them, it_s #horrible, #leading to infection, this could transmit to #humans.

144 23 it_s all the #result of #pollution, #allergies in #children these #days have #increased 10fold over the #last 20 #years. A: that_s just so true, I #mean with #asthma #especially.

438 23 it_s not #normal, it_s not #human, it_s not the biological way to #grow things. MW: but #traditional agriculture also #uses #plant #breeding, they also splice a #plant and then #grow it #differently, with #bigger #fruits or something.

27 22 for #example, some #types of #gm #vegetables and #plants have been #created to #resist more the aggression of #chemicals, so that they can be sprayed more often and #grown more vigorously.

379 22 this is a #level of #modification which is more or less common and acceptable. on the other #hand, once you #start having the german shepherd with a #sheep or whatever, this is #different, it_s #unnatural as it couldn_t #happen in #nature, and so it should be in a #different #category of #gm.

439 22 the #difference with #gm is that #foreign #genes from practically every other #species can be #incorporated and that_s #different. this could be #dangerous but if #genetically we are all the #same and we share 95percent with #plants then it should not make a #difference.

441 19 S: I #worry very much about #cross #contamination of #plants, the seeds of #gm #plants can wafts #miles #into other territories of #fields which are not #gm and that_s #polluting them then.

591 19 D: on the other #hand, there is no #immediate #danger to us, is there? I #mean, #smoking 2 packs of cigarettes a #day will #kill me first before any #gm!

674 19 DE: I just know they are #related, you #mix them #up. for #example, they can #put #chemicals in the #genes to make #tomatoes #last #longer. they are basically #putting something in that just should not be there. and we already have so many #problems with #chemicals in our foods, #pesticides and all this #stuff.

44 17 I do not #drink #milk anymore because I know the #cows are injected with #hormones and I do not like that. I do not #eat #chicken anymore because I know they #put god knows what #into them to make them #grow faster and #bigger.

305 17 on the one #hand I think it_s #complete #tampering with #nature, on the other #hand, #maybe it_s just evolution with a helping #hand. what I #mean is that #gene #modification is #happening #naturally but now we_re doing it #artificially. I do not know.

555 16 you #eat that now thinking it_s a #normal #tomato and what might #happen in 5 #years? you just do not know! the bad #genes might get #incorporated #into our #bodies.

628 16 H: but that doesn_t #mean it_s #healthier and it doesn_t #mean it_s better! T: no of #course not, it_s just the way #life #moves on, progress #happens. H: but it_s a #different conversation of whether we_re moving along to something better or #worse.

268 15 but what can you do, you have to get on with your #life. G: this was also a big #problem in ireland. the #farmers really suffered as a #result of #chernobyl, #sheep were #dying or had to be #killed, #same with foot_and_mouth, can you #imagine what #gm might do?

431 15 on the other #hand, if they stick with only #inserting #plant #genes as is done in #traditional #plant #breeding it_s the #same thing. that should not make any #difference to the #health #effects of the foods. but adding #animal #genes is #different, I do not know why they are doing it and I do not really think they should although it may not be harmful.

575 15 I #mean why do it in the first place? D: #gm also just doesn_t #taste right, you can #taste the #difference #immediately, the #fruits are full of #water and #stuff.

5 14 I like #natural things and that technology is surely not #natural. they just #mix #genes and #chemicals and nobody knows what

will #happen. you #put things #into your #body and they #mix with your #genes.

Clé sélectionnée: (D) Science and politics

81 20 at the #moment I do not #know that and unfortunately we have a #history here in the uk with the #government not #telling the #truth. so why should I #believe them now? it_s the #lack of #knowledge that #scares you the most, the #fact that you #really do not #know #what_s in your food, whether it_s been modified, how has it been modified?

485 16 DI: there isn_t any #clear #information. V: maybe not for us, but I think they #know, they have the #facts. DI: I do not #know about that. I think there are just too many unanswered #questions for all of us #really. I do not #know, perhaps there is more #information on the #internet.

593 14 they #knew well before that but because the tobacco #industry is such a profitable #industry they #tried to #keep it #quiet. the same #thing might happen with gm. S: yes, there_s so much profit #involved that #governments are unlikely to #base their #decisions #purely on #science #facts.

30 13 I_m not able to #decide whether gm is a good #thing or a #bad #thing, I just do not have the #information. A: I #agree, the #government hasn_t #really #told us the #details.

181 13 and we do not have that for gm. also, I do not think we #take #risks just like that, medical #research was well planned and #regulated. and it always served a #clear #purpose, so I would #trust doctors.

325 13 the #thing is you can not #really #stop #progress. in that respect, the #best #thing you can do is to have this #progress but with good supervision, good #research.

690 13 and you do not #know if you can #trust the #government D: exactly I do not #believe them! so #what_s the point of more #information? P: it would be good to get a #balanced view, you #know the good #things, the #bad #things and then we could make a #decision, but I think the #government has already #decided for us!

697 13 so everything you #find in the #media, you do not #really #know whether this is #true or not, and especially with gm there_s a lot of conflicting #information #out there. S: but they can not #lie about the procedures, these are #facts.

599 12 I do not #know much about it, but the #thing that #worries me is why do they #keep it #quiet? I mean if there are #risks #tell us what they are exactly and then #let us make a choice whether we want to #take the #risk or not!

776 12 I #hate to sound ignorant, but I #really do not #know much about it. there are some #scientists #out there who #know more, but they might be #biased, they might be #influenced by #politics, by the #industry D: you do not #know what to think B: they also #seem to change their #mind rather frequently A:

134 11 to be honest tonight I_m #finding #out all that #bad #things #really. I mean I do care about it and I_m against gm, but I do not #know the #details, it_s just a gut #feeling.

341 11 so it_s not #really an #issue of if or when it will happen, but of how S: but that_s the #issue of #regulation! you can not just ban and #stop it RB: the #thing is #government and #industry work together.

350 11 it wasn_t very #clear to me at all RB: I try to #find #out about it as well in #science journals but I #find it rather #difficult to #understand, I_m not a #scientist I: plus, there is not much consensus at this #moment in time is there?

395 11 I think it_s a #question for a lot of people I: the #question is basically can we #trust the #government to put our #safety first, to #really have our #best #interest at #heart.

536 11 MW: I think the #real danger is the #commercial aspect of the whole adventure. if it was #pure #science, done by the #best #independent #scientists without #vested_interests, it would be much better, it might be something I could #agree on.

725 11 it_s amazing! EF: and why do not we hear about it, I think the #government doesn_t want us to. P: I would be #interested in #finding #out more about it but I do not #really #know how to D: we have to #know the #facts.

77 10 and the #state needs to #decide to what extent it should be developed and what is the roadmap. at the #moment these #decisions are #taken by the companies and I do not think that_s right because they only have their #commercial #interests at #heart.

339 10 #say a #drug that might be #fine for a sporty male, may be fatal to a little old lady or a baby. how do we #know this is not going to be the #case with gm_foods? S: I #agree that should be better #regulated and these #things should be stopped MG: and with this in #mind, how can we #trust the product?

695 10 H: but how are you going to #find the right #information? how are you going to #decide whether it_s good for you or #bad for you? S: yes you do not #know that until you have some outcomes, we just can not #tell now.

APPENDIX D: CORA CORRESPONDENCE TABLES

Correspondence Table: *Natural things*

Association	Rating					Total
	<i>very positive</i>	<i>positive</i>	<i>neutral</i>	<i>negative</i>	<i>very negative</i>	
Sunshine	17	3	0	0	0	20
Natural disasters	0	1	1	3	13	18
Love	15	2	0	0	0	17
Sex	9	8	0	0	0	17
Life	8	3	2	0	0	13
Family	7	5	0	0	0	12
Emotion	0	5	3	2	1	11
Earth	5	5	0	0	0	10
Sky	6	4	0	0	0	10
Recreation	5	4	0	0	0	9
Eating	4	4	0	0	0	8
Green	5	1	2	0	0	8
Cotton	2	4	2	0	0	8
Health	5	3	0	0	0	8
Rocks	1	3	3	1	0	8
Air	4	2	0	0	0	6
Death	0	0	2	3	1	6
People	2	3	1	0	0	6
Dirt	0	0	1	4	0	5
Smiles	4	1	0	0	0	5
Total	101	60	16	13	15	205

Correspondence Table: *Natural food*

Association	Rating					Total
	<i>very positive</i>	<i>positive</i>	<i>neutral</i>	<i>negative</i>	<i>very negative</i>	
Health	26	5	0	0	0	31
Organic	7	10	1	0	1	19
De-naturalised foods	0	0	1	2	8	11
Taste	7	3	0	0	0	10
Not processed	5	3	1	1	0	10
Straight from the farmer	6	2	2	0	0	10
Purity	7	2	0	0	0	9
Expensive	1	0	1	4	2	8
Farming	3	2	2	1	0	8
Culture	4	2	1	0	0	7
Fair-trade	4	3	0	0	0	7
Fresh	5	1	0	0	0	6
Homemade	5	1	0	0	0	6
Mcdonalds	0	0	0	0	5	5
Rare	1	0	0	2	2	5
As nature intended	3	1	1	0	0	5
Vegetarian	0	0	3	1	0	4
Cooking	0	1	0	2	0	3
Harmony	2	1	0	0	0	3
My garden	3	0	0	0	0	3
Total	89	37	13	13	18	170

Correspondence Table: *Food in general*

Association	Rating					Total
	<i>very positive</i>	<i>positive</i>	<i>neutral</i>	<i>negative</i>	<i>very negative</i>	
Family and friends	17	8	0	1	0	26
Culture	11	7	4	0	1	23
Social event	14	5	2	0	0	21
Pleasure	15	4	3	0	0	22
Cooking	6	6	3	4	0	19
Taste	14	4	0	0	0	18
Health	9	6	3	0	0	18
Fat	0	0	2	4	9	15
Meal	5	4	1	1	0	11
Hunger	0	1	1	5	3	10
Diet	3	1	2	3	0	9
Home	7	2	0	0	0	9
Nutrition	4	4	1	0	0	9
Essential	1	4	3	1	0	9
Energy	4	2	2	0	0	8
Relaxation	6	1	0	0	0	7
Life	3	2	2	0	0	7
Organic	5	2	0	0	0	7
Satisfaction	4	3	0	0	0	7
Risk of weight gain	0	0	0	5	1	6
Total	128	66	29	24	14	261

Correspondence Table: *GM food*

Association	Rating					Total
	<i>very positive</i>	<i>positive</i>	<i>neutral</i>	<i>negative</i>	<i>very negative</i>	
Unnatural	0	0	3	14	13	30
Science	5	6	8	2	1	22
Helping third world	8	8	2	3	0	21
Unhealthy	0	0	2	5	14	21
Multinational companies	0	1	2	11	5	19
Progress	4	9	2	0	0	15
Potential benefit	5	7	0	2	0	14
Environmental risks	0	0	0	8	6	14
Dangerous	0	0	1	3	9	13
Uncertainty	0	0	0	7	5	12
Profit	0	4	1	1	5	11
Exploitation	0	0	1	1	8	10
Future	0	4	6	0	0	10
Government lies	0	0	0	8	2	10
Unknown long-term consequences	0	0	0	6	3	9
Tasteless	0	0	0	4	4	8
Big	0	1	2	5	0	8
Not necessary	0	0	1	3	4	8
Contamination	0	0	0	3	5	8
Greenpeace	2	4	0	2	0	8
Total	24	44	31	88	84	271

APPENDIX E: PROCEDURE FOR CLUSTER ANALYSIS

Procedure for cluster analysis using Jaccard's coefficient and the Centroid linkage method

First a proximity matrix is calculated, consisting of a similarity measure for each pair of variables. The similarity measure used here is Jaccard's coefficient. To illustrate how this is calculated, we provide the example of the similarity measure between *science* and *progress*. This is calculated as the number of respondents who mention both *science* and *progress*, divided by the following sum: the number who mention both, plus the number who mention just *science*, plus the number who mention just *progress*. Note that the calculation excludes those respondents who mention neither *science* nor *progress*.

The original data file (not presented here) shows that:
8 respondents mention both *science* and *progress*,
11 respondents mention *science* but not *progress*,
6 respondents mention *progress* but not *science*.

Therefore Jaccard's coefficient of similarity between *science* and *progress* is:

$$\frac{8}{8+11+6}$$
$$= 0.320$$

Then the clustering begins. First, the most similar pair of items is identified, that is, those with the largest similarity coefficient. In this data set, this is *science* and *progress*, with similarity = 0.320 as shown above. These two items form the first cluster. The proximity matrix now has to be updated, since new similarity coefficients must be calculated between the *science-progress* cluster and the other variables. The new similarity coefficients between this cluster and each new variable are calculated as a weighted combination of the similarities as they were for *science* and *progress*. Five pieces of information are needed for this.

First, the labels:

s = Jaccard's similarity coefficient

a = *science*

b = *progress*

c = *unnatural*

n = number of variables in a cluster.

NB although at the moment we are dealing with merging single variables, one could think of those variables as clusters each with $n=1$. This makes the formula below generalisable when we start merging clusters containing more than one variable each.

Now, the five pieces of information that are needed:

s_{ac} = Jaccard's similarity coefficient between *science* and *unnatural* (= 0.179)
 s_{bc} = Jaccard's similarity coefficient between *progress* and *unnatural* (= 0.079)
 s_{ab} = Jaccard's similarity coefficient between *science* and *progress* (= 0.320)
 n_a = number of variables in the 'cluster' *science* (=1)
 n_b = number of variables in the 'cluster' *progress* (=1)

The new similarity measure between the cluster *science-progress* and the variable *unnatural* is:

$$\begin{aligned}
 &= \left(\frac{n_a}{n_a + n_b} s_{ac} \right) + \left(\frac{n_b}{n_a + n_b} s_{bc} \right) - \left(\frac{n_a n_b}{(n_a + n_b)^2} s_{ab} \right) \\
 &= \left(\frac{1}{2} 0.179 \right) + \left(\frac{1}{2} 0.079 \right) - \left(\frac{1}{4} 0.320 \right) \\
 &= 0.049
 \end{aligned}$$

(So if there were more variables in cluster *a* than in cluster *b*, then when calculating the similarity coefficient between cluster *ab* and new cluster *c*, the similarity between *a* and *c* would have a greater weighting than the similarity between *b* and *c*.)

This is repeated for all the other variables. The whole process is now repeated: the next most similar pair of items (or pair of cluster-and-item, or later, cluster-and-cluster) is identified, by finding the largest Jaccard coefficient. The new cluster is formed, and the proximity matrix is updated. And the clusters are combined until the completion of the analysis.

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