Consumer perceptions of food products from cloned animals: A social scientific perspective

Prepared for the European Food Safety Authority

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November 2007

Foreword

From the early days of its establishment, EFSA has engaged actively with stakeholders, demonstrating its commitment as an organisation to openness, transparency and dialogue. In June 2005, the EFSA Management Board agreed to establish a Stakeholder Consultative Platform, composed of EU-wide stakeholder organisations working in areas related to the food chain. The Platform meets to assist EFSA in the development of its overall relations and policy with stakeholders. At its meeting in April 2007, EFSA discussed with Platform members the opportunity of broadening its social dialogue, notably on issues that could be identified as sensitive, for instance with respect to new technologies, and where consultation of interested parties is considered essential to encourage the understanding and acceptance of EFSA's scientific work.

EFSA's new risk assessment mandate on animal cloning was seen as such an area where the Authority could engage in a wider debate with interested parties, also with respect to the non-scientific aspects of animal cloning. This parallel debate would not interfere with the work of EFSA's Scientific Committee but would help to better understand and anticipate societal views and set a context for EFSA's scientific work.

At a meeting in May 2007, EFSA's Advisory Group on Risk Communications (AGRC)[1] discussed EFSA's work on animal cloning, notably with respect to future risk communications and social dialogue.
In light of the discussions at this meeting, EFSA decided to organise a one-day workshop[2] with social science experts in order to help inform EFSA's future scientific work, stakeholder dialogue and public communications related to animal cloning, in particular concerning public perception and other societal aspects related to this new technology.

This report drafted by George Gaskell, member of the AGRC, summarises the workshop's discussions and outlines areas of consideration for EFSA in preparing for future communications and stakeholder dialogue related to the Authority's risk assessment on cloning.

European Food Safety Authority
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[1] EFSA's Advisory Group on Risk Communications provides advice to the Executive Director on risk communications issues and practices. The Group also advises on risk perception and the impact of risk communications on consumer attitudes. Members provide a wide range of expertise in fields relevant to risk communications such as sociology, consumer science, psychology and communications.

[2] Participants at the workshop held on 26 June 2007 included Anne-Laure Gassin (EFSA) and George Gaskell (LSE) (co-chairs), David Carlander (EFSA), Claude Fischler (CNRS/EHESS), Jürgen Hampel (Stuttgart), Juliane Kleiner (EFSA), Nicole Kronberger (Linz), Jesper Lassen (Copenhagen), Christine Majewski (EFSA), Carola Sondermann (EFSA) and Karen Talbot (EFSA).

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1: Summary

A social scientific view on animal cloning for food products

In the view of the authors of this report converging lines of theoretical and empirical research suggest that cloned meat is likely to be a controversial issue with the European public, sitting as it does at the nexus of sensitivities around food, animals and the life sciences. If, as appears probable, the next step is to combine transgenics with cloning, then the potential for controversy will be amplified.

The key role of unique benefits

Whether cloned meat, and other food products from cloned animals, are seen to offer benefits will be an important factor as the perception of benefits leads to the discounting, or a least tolerance, of risk. However, the nature of benefit is complex. Medical biotechnologies are widely accepted as they are seen to solve problems where no other available alternatives exists – a societal benefit. This contrasts with GM food for which sections of the public feel that there are readily available alternatives. Economic benefits accruing to sectional interests, for example industry, are not seen by consumers as benefits.

Clones: contested definitiions

Informed by science, regulators will determine what is and what is not a cloned animal. Regarding the progeny of cloned animals it may be concluded that these are substantially equivalent to their conventional counterparts i.e. not clones. Whether such a scientific definition will be accepted in the public domain is open to question. On account of their unnatural parentage, we suspect that sections of the public will lean more toward the 'cloned' rather than the 'conventional' category.

Labelling

Imposing new products on the public without appropriate labelling denies consumer choice and runs counter to consumer protection legislation in Europe. It is likely that even if cloned meat is shown to be substantially equivalent to conventional meat, sections of the public will demand labelling. While labelling based on scientific analysis or traceability may present considerable challenges, if such demands are ignored the voices of protest will be amplified.

Derivatives of cloned animals

All the evidence in the Western world identifies meat as the most problematic food stuff and close behind probably comes milk. What may be the consumer perception of the derivatives from cloned farm animals – milk products and fats etc? So-called vegetarian cheese – with GM enzymes replacing rennet is widely accepted, but other GM crops and food remain problematic. A recent petition of over 1.000,000 Europeans called on the European Commission to legislate that food products such as eggs, meat and milk where the animal had been fed with GM crops should be labelled as such. However, the available research is insufficient to draw conclusions on the likely reception of cloned animal derivatives.

Environmental and animal ethics

Two other issues may emerge as points of contention over cloned animals. Animal welfare and possible environmental/biodiversity impacts. Across the EU member states these two issues have differential salience – for example animal ethics is more of a preoccupation in the Northern member states. But once a concern is raised in a particular Member State, there is a tendency to see its Europeanisation.

Risks for EFSA

EFSA's scientific opinion will advise on food safety, animal health, animal welfare and environmental implications of animal cloning. Without presupposing the outcome of this advice, if EFSA's scientific opinion were to conclude that cloned meat presents no greater risks to the public than conventional meat, the Authority may be seen by the public as implicitly endorsing the principle of cloned meat. We believe that if the risk managers do not recognize the import of 'other factors' then EFSA's science based position may come into conflict with public perceptions. The result could be a re-run of the clash between the two cultures of risk that has dogged GM food and crops. In such a situation trust in EFSA and other EU bodies may be jeopardised. In this regard the separation of risk assessment and risk management may have solved some problems but may well have created others. At minimum EFSA and DG SANCO need to agree a consistent and proactive strategy for informing the public and all interested parties of the key steps in the evaluation and decision-making process, explaining the roles of the different institutions – risk assessment and risk management - and publicising details of opportunities for engagement.

Impacts of a reserved opinion

Another possible scenario is a qualified or 'reserved' scientific opinion from EFSA. The reservations might highlight one or more areas of uncertainty for instance – and for illustrative purposes only -- with respect to animal health or animal welfare issues. How would such an opinion impact on public perceptions? If there is a precautionary response to such reservations that results in keeping cloned products out of the food supply then the issue may remain largely unnoticed by the wider public. However for the 'concerned' public, those individuals and groups with an interest in the issue, it will be taken as a strong signal that animal cloning is problematic.

Given that any scientific reservations are likely to lead on to further research to clarify possible risks – and in illustrative example above – the moral and ethical dimensions of the animal welfare issues, an opportunity is presented to EFSA to proactively seek the opinions of the stakeholder community about the framing of the further research and its interpretation.

Social dialogue

In our view it is likely that the focus of public concerns will lean towards cultural taboos and semi-taboos rather than challenges to the scientific evidence. While retaining the independence of scientific risk assessment a social dialogue should map the other factors that are likely to drive public perceptions, recognize that consensus across the publics of Europe may not be possible and ensure that all decisions are fully justified and the reasons for rejecting certain positions fully explained. For EFSA and DG SANCO, the reality and appearance of procedural justice should be a priority.

2. Introduction

The Center for Veterinary Medicine at the US Food and Drug Administration published a draft risk assessment of cloning in species traditionally used for food (cattle, swine, sheep and goats)[1]. On the basis of the available scientific information the draft report concludes that "edible products derived from the progeny of clones pose no additional food consumption risk(s) relative to corresponding products from other animals …". It also notes that while "there is an increased frequency of health risks to animals involved in the cloning process …. The situation appears to be improving as the technology matures" As of today there is a voluntary moratorium in the US on the commercialisation of animal cloning for food supply. However, if the draft report is accepted then products from cloned animals will enter the US food chain and come under the auspices of international trade regulations.

In this context the European Commission requested a scientific opinion on animal cloning from the European Food Safety Authority (EFSA) with the following terms of reference. "….. to advise on food safety, animal health, animal welfare and environmental implications of live cloned animals, obtained through somatic cell nuclear transfer technique (SCNT), their offspring and the products obtained from those animals". EFSA's remit is to formulate an opinion based on the scientific evidence.

At the same time the European Commission has asked the European Group on Ethics in Science and New Technologies (EGE) for an opinion on the ethical aspects of animal cloning for food supply. The EGE launched a public consultation inviting interested parties to comment on two questions:

- What is in your opinion the main ethical concern about animal cloning for food supply?
- What do you think should be done at EU level?

The EGE also held a Roundtable in Brussels in September 2007.

At a meeting in May 2007, EFSA's Advisory Group on Risk Communications (AGRC) discussed EFSA's future work on cloning, notably with respect to future risk communications and social dialogue. The Advisory Group was concerned that a 'no greater risk' scientific opinion might be at variance with the perception of the wider European public. Animal cloning for food products brings together animals, food and meat, and the life sciences. On each of these there is a literature of theory and empirical research that points to the existence of public sensitivities. The combination of the three in animal cloning for food supply may well be socially problematic.

In light of the discussions at this meeting, EFSA decided to organise a one-day workshop with social science experts in order to help inform the presentation of EFSA's future scientific work, stakeholder dialogue and public communications related to animal cloning, in particular concerning public perception and other societal aspects related to this new technology.
The workshop was structured around the following key questions:

(1) what has been learned from the debates surrounding introduction of new technologies, notably in the food sector, that may be relevant to the issue of animal cloning?
(2) are there any relevant insights from the social sciences and humanities that might contribute to an understanding of public views, including identification of critical issues and factors, and reactions to animal cloning?
(3) how should social dialogue regarding risk assessment on such a potentially controversial technology be organised?
(4) are there likely to be differences in consumer views and reactions across the European Member States?

This report is a summary and development of the discussion at this meeting and is presented to EFSA to assist the Authority in undertaking further dialogue with interested parties and engaging in public communications related to its new mandate on cloning. The report reviews the social scientific evidence about 'other factors' (extra-scientific) that may be influential drivers of public perceptions.

Although our conclusion is that animal cloning for food supply is likely to be socially sensitive in Europe, it is based largely on indirect evidence. It is possible that we may have missed evidence that points to the likelihood of more positive public/consumer perceptions. Equally, we may have over-estimated the social sensitivity of the issue.

As a final point to this introduction, let us make our intentions clear. We are not arguing against science based risk assessment. In this report we attempt to sketch out, as dispassionate social scientists, possible scenarios of consumer/public perceptions of animal cloning for food products. We believe that risk assessors and risk managers will be better informed if they are aware of these scenarios and their implications. In this sense we use the social sciences as a radar screen, an early warning system that identifies potential problems on the horizon and invites the competent national and European authorities to consider appropriate responses.

3. The context: food, biotechnology, public rationalities and risk

Food and eating

Food, cloning and genetic modification bring together the new and the old. Genetic modification has a short history dating back to the 1970s with the development of rDNA. It was only in the early 1990s that so-called vegetarian cheese made with a GM enzyme, and subsequently the GM tomato emerged as consumer products. Cloning moved from science fiction to reality in 1997 when a startled world was introduced to Dolly the Sheep. By contrast, the production, preparation and consumption of food are as old as human (and even primate) society. Over the millennia and across the world, food and eating, while arguably the most basic biological function, have evolved to be a central feature of culture - shaping social organisation, social and family relations, the division of labour, and demarcating religions, races, communities, classes and genders.

Food is constitutive of both cultural and individual identity through the process of 'incorporation' - the crossing of the barrier between the 'outside world' and the 'inside world' of the body. Food intake is not merely physical. With the food we also absorb beliefs and collective representations – as suggested by the age old aphorism 'you are what you eat'.

In the Western world the last half century has witnessed a change from food shortages to surpluses. Anxieties about having enough to eat have been replaced with concerns related to the ever increasing distance between 'the farm and the fork'. The modern eater is an increasingly anxious consumer, torn between the appeal of cheap, convenient and palatable processed food, and the repulsion or menace of factory farming and pesticides, new ingredients and processes and additives to replace natural ingredients etc. The perceived, and to some extent, real consequences are new and subtle dangers, less visible, understood or controllable. In this context trust becomes a crucial issue, as trust acts as a substitute for knowledge[2]. Beyond social networks, consumers need to be able to rely on experts, hence the importance of trust in public authorities, scientists, consumer associations, doctors, even media and brands. Plurality of information sources, notably given the internet, heightens the need for credible, authoritative information sources.

While culture gave earlier generations principles about what and what not to eat, how to prepare food and meals, the clues of texture, freshness, flavour and even intuition fail to protect us from the perceived hazards of eating in modern times. The consequent psychological, political and ethical distress resonates in worries about being 'at risk' from pesticides, residues, pollutants and additives.

Surveying consumers across Europe and North America, it appears that the growing distance from 'farm to fork' is associated with various manifestations of anxiety and concern about contemporary processed foods such as rumours about 'E-numbers' or statements such as "one does not know what one eats anymore". [3] Furthermore, experimental research in social psychology has demonstrated that the 'you are what you eat' perception (the mental representation by which the food eaten transforms the person, who takes on the food's real or imagined characteristics) is a general feature of the human mind. [4] Because it is, in part, through the food they eat humans feel they exert control over their selfhood, food is central in the cultural and individual construction of identity. Thus it appears that the need to 'know what one eats' cannot be seen as just an irrational feature of weak and ignorant minds. It encapsulates a contemporary food consumer's dilemma: "If I am what I eat and I don't know what I eat, how can I control who/what I am ?"[5]

With the decline of tradition and culture we see the emergence of individual choice – for some desirable, for others the cause of anxiety, bewilderment and the state of 'gastro-anomy'. Individuals are often at a loss as to how to make choices in the general nutritional cacophony - conflicting norms (or normlessness), prescriptions and proscriptions about food. Anxieties about food are evidenced in food scares, pathological eating disorders and a normlessness that some social scientists link to the trend of rising obesity. All in all, in our modern times food and eating are as likely to be seen as a source of stress as a pleasure.

To 're-identify' with food, to re-appropriate it ("knowing what they eat") people search for new strategies, seen in the demand for food labelling, legal protection against the use of chemicals and biotechnology, the adoption of individual alternative diets, ranging from more or less rigid vegetarian, organic, low-calorie or low carb etc.

Food anxieties have led to new 'strategies of confidence' including the development of repertoires of trusted food, for example organic food, fair trade, vegetarian or local food; brand loyalty – with brands standing for familiarity and reassurance of safety and quality.

Of all the food products eaten by human omnivores, meat is both the most adored and the most abhorred[6]. On the one hand, almost all the food taboos (as well as the most violent aversions) centre on meat or animal foods, some by religious fiat, others reflecting no less constraining cultural preferences – "would you care for a real dog hot dog?". On the other hand, meat is culturally focal – the English Sunday roast and steak for the French. In the years that ended with the fall of the Berlin wall, it was not for bread and circuses that people in the Central and Eastern European countries longed for – it was meat – as numerous jokes of the time attest.

Meat necessitates the killing of animals, an act endowed with meaning when performed as ritual sacrifice but apparently increasingly problematic when reduced, as it were, to its bare mercantile essentials. Because of this fundamental duality, adoring and abhorring, animal foods in general and meat in particular are, probably more than any other category of foods, subject to rumors, scares, sudden breakouts of disgust and crises of confidence. Was it not the crises of BSE in cattle and dioxin in poultry that led to the establishment of EFSA?

Finally, there is the issue of naturalness. In many, if not all cultures, but at the very least in the United States, France, Britain, Switzerland, Italy and Germany, the adjective "natural" associated with food is considered positive[7]. As such it is a common theme in the advertising of food products.

Naturalness is affected more, in people's perception, by addition, even infinitesimal, than it is by subtraction; by process rather than by content; by chemical than physical transformation; by contaminants and above all by genetic engineering. The greater the intervention, the more will food be perceived as unnatural and undesirable. What of food products from animal cloning?

Observations on 15 years of biotechnology

The history of public perceptions of the Life Sciences, and in particular the troubled history of GM food, provides some interesting insights into the dynamics of public perceptions and offers some useful lessons for those wishing to avoid the surprise of unexpected public reactions and to pursue socially robust innovation strategies whether in novel technologies or foods[8]. Two of the general lessons are that social and ethical issues should be taken into account at a formative stage of the innovation process and that market success requires more than regulatory approval and the support of producers.

It is a striking fact that the many widely accepted medical applications of the Life Sciences – for example medicines, vaccines and genetic testing - were subject to both scientific and ethical scrutiny. The same cannot be said for GM food which, until 2001 was assessed solely on the basis of scientific risk assessments. The neglect of consideration of the social and environmental impacts contributed, in part, to the extended controversies that continue to this day.

Equally striking, is that the GM industry assumed that with regulatory approval and the support of farmers, the market was secure. What they did not appreciate is that the environment into which GM crops and food was introduced included the public, in the roles of decision makers both as citizens (qua voters) and as consumers (qua purchasers). And it was the public in these two roles that influenced national governments, food manufacturers and the supermarket chains. Undoubtedly the NGOs and the media played a role in mobilizing public opinion, but there is a good case to be made that these intermediaries were led by public concerns, that had been evident in survey research from the 1980s[9].

The drivers of public perceptions – both positive and negative – have implications for technological innovation in general and for development of animal cloning in particular. In this paper we review, from the perspective of the social sciences, a range of concepts and empirical research that may help to anticipate consumer reactions to animal cloning for food. In our view as social scientific observers of different aspects of the public responses to the development of the life sciences, the public is not wholesale anti technological innovation and that socially robust innovation is possible providing that the lessons of past controversies are learned.

Plural rationalities

Here we introduce some important ideas from recent social science which provide a description of the public that corrects some misconceptions that have been rather influential. We ask non-social scientists to bear with us in the hope that their effort will be repaid.

Much research in the aftermath of the so-called 'cognitive revolution' (and including studies of the public perception of technologies) is based on a model of people as *intuitive scientists* or *intuitive economists*, searching for truth and striving for the maximization of utilities[10].

With people seen as intuitive scientists or economists came the assumption that they would be interested in scientific evidence and in probabilistic conceptions of risk to evaluate technological developments. On the level of science communication, initiatives set out to 'educate' and 'inform' the public. However, research on public perception showed that experts and lay people have rather different ways of thinking about risk. Compared to expert judgment, everyday thinking is not concerned with scientific detail, and when it comes to risk and probabilities, it is sometimes subject to systematic biases. But what also became apparent is that people are not only self-interested individuals concerned with maximising their utilities. There are at least two more models that capture ways of everyday thinking; *intuitive politicians* and *intuitive ethicists.*

When thinking like an *intuitive politician* people are concerned with fairness, the balancing of social interests, with distributional and procedural justice and the avoidance of social exploitation. Questions like 'who is affected?', 'for whom are technologies potentially risky and beneficial?', or 'is the technology in safe hands?' play a role here.

Thinking as an *intuitive ethicist,* people are driven by the existential need to believe that the rules governing their worlds are not just the arbitrary preferences of powerful groups but rather are anchored in core values that legitimise collective practices. Consequently, people set out to protect such values from encroachments by society, and for example by science and technology.

A realistic model of human nature will expect people to switch between these intuitive logics or to experience tensions between them, even if there may be propensities for different groups of people to think in terms of one of the logic rather than another. Consequently, there is a need to consider what clashes between the logics might arise in everyday life, both on the level of the individual, and on a societal level. When Oscar Wilde described economists as knowing the price of everything and the value of nothing, he referred to one of these tensions. Modern humans, taking both the perspectives of *intuitive scientists/economists and ethicists*, for example, frequently struggle with competing themes, such as for example the idea of respect for nature and an urge to conquer or master it[11].

Reasoning as an *intuitive politician* has been identified in a number of empirical studies. These show that procedural fairness and equity-issues are highly important in the context of perceptions of technology. Rayner and Cantor[12] even suggest that the question 'how safe is safe enough?' should be replaced with 'how fair is safe enough?'. These authors argue that risk management based on the ideal of utility maximisation often produces outcomes that are obviously unjust. It is a common problem of tradeoffs on a societal level, that benefits and costs rarely go to exactly the same persons. What may be good for most people may carry disadvantages for others; what can help the few can be costly for the many.

Furthermore, how people assess a situation depends not only on the outcome but also on how the outcome is achieved; procedural justice is as relevant for evaluation as are distributional concerns and utility considerations. Research on the role of trust in risk management addresses this aspect. With the emergence of 'science and society' the interests of the *intuitive politicians* often are addressed by way of public engagement (such as stakeholder consultations, citizen juries, deliberative opinion polling, hearings, consensus conferences or national debates) to re-establish trust and signal transparency of decision-making.

To date, the perspective of the *intuitive ethicist* has received least attention, even though there is an increasing recognition that modern technologies often touch on highly charged issues of social values, such as human identity and dignity, and what is nature and the natural. Crucially, these ideas impact on people's evaluation of technological innovation.

All these forms of reasoning may be used to evaluate sensitive technologies as either good or bad, however, it is only the *intuitive scientist/economist* that can be expected to base his or her judgment primarily or exclusively on expected consequences (i.e. on consequentialist, utilitarian grounds).
Intuitive politicians and ethicists may well base their approach on non-consequentialist logics, such as distributional and procedural fairness or other core values. It should not be forgotten that all models suggest moral stances, however, the utilitarian ideal is the one closest to science and technology policy and expert risk assessment.

These models of intuitive reasoning suggest that it is not appropriate to draw a sharp distinction between consumers (presumed to be *intuitive economists*) and the public (taken as an unpredictable mixture of *intuitive scientists, economists, politicians*). Consumers express their preferences on economic and other grounds – paying more for fair trade products, avoiding products from sweat shops in developing countries etc. This is equally true in survey research where respondents may answer questions from both the perspectives of consumer and citizen.

The two cultures of risk

The tension between different ways of thinking about the world brings into focus the two cultures of risk - the gap between scientific and societal thinking about the issues of risk and uncertainty[13] [14]. Essentially, confronted by the same putative hazard the approach adopted in science is, on occasions, strikingly different to the approach taken by the public.

The scientific definition
A simple definition of risk is the probability of an unacceptable loss. The expert view of risk assessment inclines towards probabilistic models that determine the likelihood of positive and negative outcomes multiplied by the potential impacts of these outcomes. Risk assessment is under-pinned by the scientific method. The scientific method assumes that there are 'facts' about the world to be discovered and that knowledge progresses through empirical research, leading over time to a closer approximation to the truth[15]. Research that follows the canons of the scientific method is taken to be objective and unbiased by human motivations and agency. Thus, scientific risk assessment is the only recognised approach, all claims about potential risks to human health and safety must be subjected to the same criteria regarding methodology and evidence. In this way risk, supported by the methodology of risk assessment, is almost a universal currency – all things being equal, it transcends place and time.

The intuitive understanding
An alternative definition of risk is that it is a complex, socially narrated concept based on a variety of factors, cognitive and non-cognitive. In the public sphere risks may take on political, ethical and emotional dimensions[16]. For the public, the essence of perceptions of risk are not cold calculating cognitive decisions but rather fears, hopes, pleasure and anger drawing on the intuitive logics of the politician and ethicist. In different cultures and social milieus within cultures what constitutes risk may be very different. Culture, stereotypes, trust in experts and social values (amongst other things) all play a part in the identification of risks and in the amplification or attenuation of risk perceptions[17].

The implication of this is that purely science based claims about risk, and in particular the absence of risk, may not be very convincing to the public. Such claims are likely to be least convincing when dealing with a 'sensitive technology' and in situations where benefits from the innovation are in question and the existence and distribution of down side risks uncertain.

4. Public perceptions of food products derived from cloned animals

In this section we review evidence from Europe and North America that has a bearing on public perceptions of food products from cloned animals. For Europe much of the research stems from the series of Eurobarometer surveys on Biotechnology (1996, 1999, 2002 and 2005). The surveys conducted in each European Union (EU) country use a multi-stage random sampling procedure and provide a statistically representative sample of 1000 national residents aged 15 and over, giving 95% confidence limits of +/- 0.6%. Funded by DG Research, advice on survey design, analysis and interpretation was provided by an international team of social scientists[18].

Europe

In the event direct empirical evidence on public perceptions of food products derived from cloned animals is limited. Given the global reach and intensity of the debate about Dolly the Sheep in 1996[19], it might have been expected that research on the societal implications of animal cloning would have been high on research agendas. However, studies of public perceptions of genetic technologies concentrated on other issues – in particular medical and agri-food applications of biotechnology. While studies of public perceptions of cloned animals for food are scarce, a number of Eurobarometer surveys provide evidence that may indicate the likely responses to animal cloning.

In the 1996 Eurobarometer on Biotechnology (EB 46.1)[20] respondents in the then fifteen EU Member States plus Norway and Switzerland were asked to evaluate a number of applications of biotechnology on the criteria of use, risk and moral acceptability. They were also asked whether the applications should be encouraged or not (see figure 1).

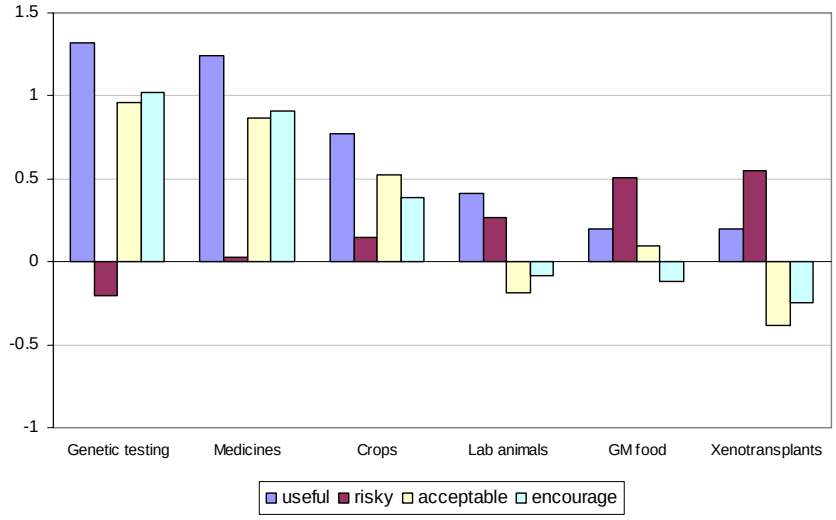
Of relevance to the current discussion, two applications about animal biotechnologies were described as follows:

- "Developing genetically modified animals for laboratory research studies, such as a mouse that has genes which causes it to develop cancer" (denoted in figure 1 as 'lab animals') and

- "Introducing human genes into animals to produce organs for human transplants such as into pigs for human heart transplants" (denoted as 'xenotransplants').

Figure 1 shows that like GM food these two GM animal applications are seen as less useful than the other three applications (genetic testing, medicines and GM crops) and they are also seen to carry more risk. Crucially, they are seen, on average, as morally unacceptable and are not thought by the public to be worth encouraging.

Figure 1: Public perceptions of six biotechnologies in 1996

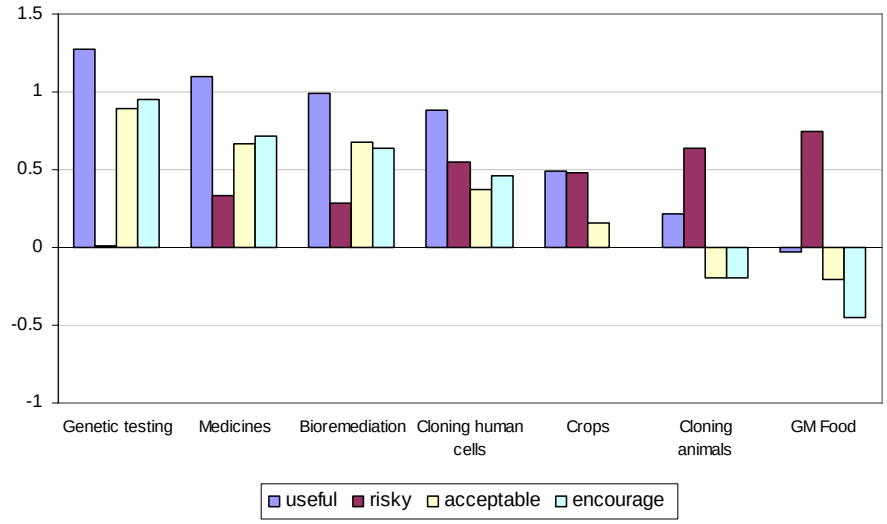


In a subsequent Eurobarometer survey on Biotechnology in 1999 (EB 52.1)[21] [22] respondents again were asked to evaluate selected applications of biotechnology; some of the applications were the same as in 1996, some were different. As in 1996, medical applications were evaluated more positively than food applications. In this survey, two 'cloning' applications were included (see figure 2):

- "Cloning human cells or tissues to replace a patient's diseased cells that are not functioning properly (cloning human cells)"
- "Cloning animals such as sheep to get milk which can be used to make medicines and vaccines" (cloning animals).

While both applications were described in the context of potential medical benefits, they are nevertheless evaluated more negatively than other medical applications. As in 1996 we find that cloning animals is seen to carry risk, to be morally unacceptable and not to be encouraged. That cloning human cells is considered less problematic than cloning animals may be due to the different perceptions of cloning relatively small body parts as against 'whole' cloning of living beings in the case of animals.

Figure 2: Public perceptions of seven biotechnologies in 1999



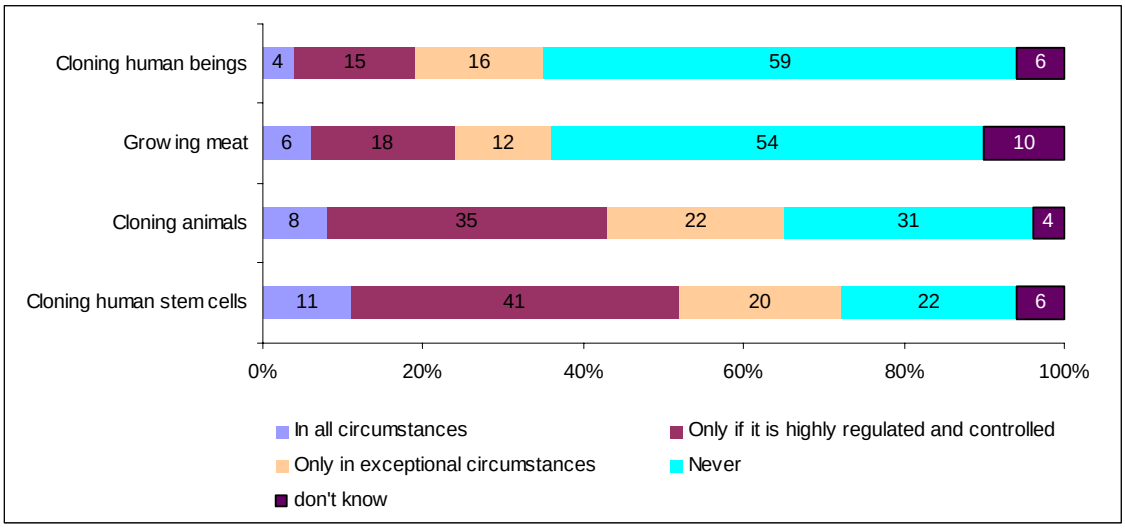
In 2005, a Eurobarometer Survey on Social Values, Science and Technology provides further suggestive insights[23]. In this survey, respondents from the 25 European member states were asked to indicate their approval of, among others, the following future technologies:

- "Cloning human stem cells from embryos to make cells and organs that can be transplanted into people with diseases",
- "Cloning animals such as monkeys or pigs for research into human diseases",
- "Cloning human beings so that couples can have a baby even when one partner has a genetic disease"
- "Growing meat from cell cultures so that we do not have to slaughter farm animals".

The response alternatives were: I approve in all circumstances; I approve only if it is tightly regulated and controlled; I would only approve in exceptional circumstances, and I would never approve.

For all three cloning applications, there is a sizeable percentage of the European public responding that they would never approve of these developments: cloning human beings 59%, cloning animals 31% and cloning human stem cells 22%. Of relevance to cloning animals for food, the idea of producing meat from cell cultures is rejected with 54% of the respondents.

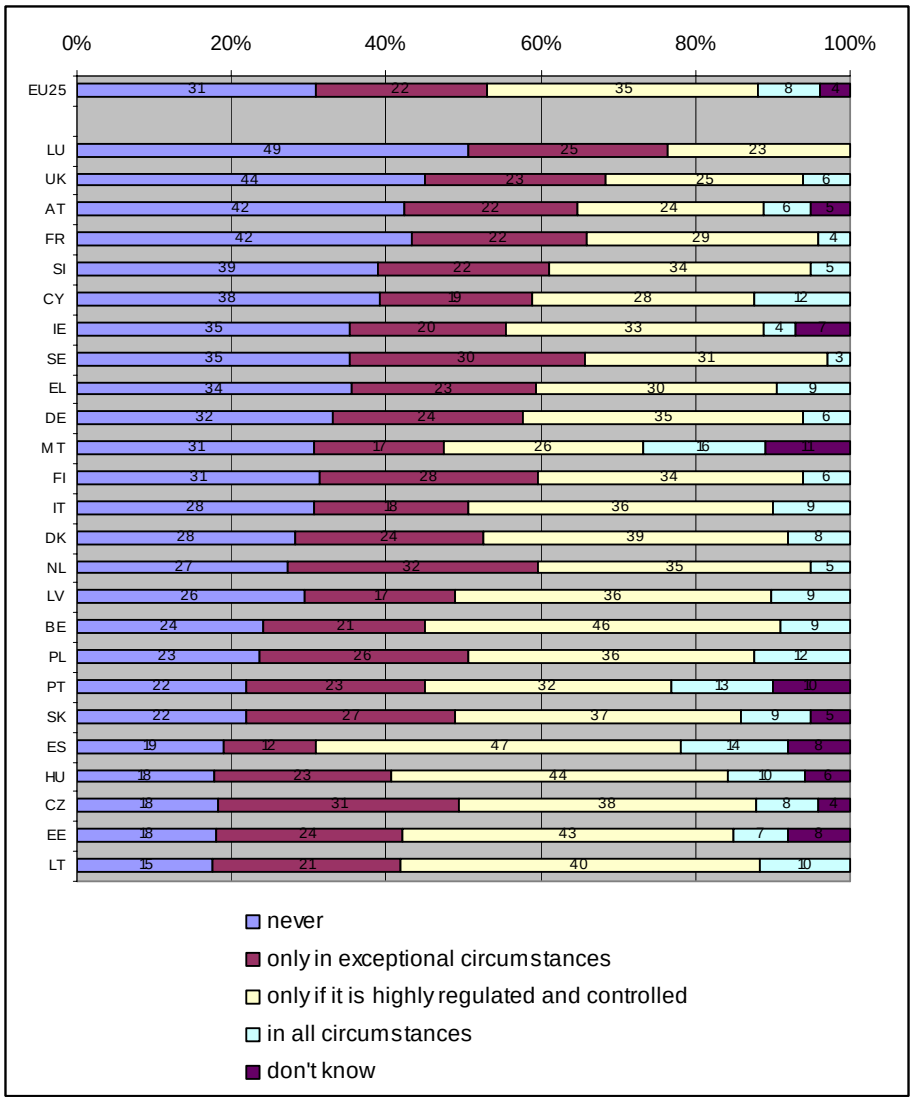
Figure 3: Public perceptions of cloning in 2005



From the Eurobarometer on Social Values, Science and Technology we can assess the relative sensitivity of cloning animals across Europe by taking the question; "Cloning animals such as monkeys or pigs for research into human diseases".

As seen in Figure 4, in 16 out of the 25 European member states, at least twenty five per cent of respondents say they would never approve this future technology. Combining the responses 'never' and 'only in exceptional circumstances' which amounts to a near veto, we see that all the countries from the top of the figure down to Germany, plus Finland, Denmark and the Netherlands have an absolute majority of the public exercising the veto option. Given that this is a case in which cloning is described in a context of promising medical benefits, the number of countries where the public is opposed must be seen as a warning for animal cloning.

Figure 4: Approval of cloning animals for research across the EU Member States



Finally, we present some findings on public concerns about new technologies applied to food, more specifically the genetic modification of food. Admittedly, the USDA and EFSA are currently assessing animal cloning for food products. However, according to one press report the USDA is said to be 'abdicating its responsibilities' in delaying the regulation of transgenic animals that now include experimental pigs, goats, cattle and salmon[24]. It is widely believed that animal transgenics is the commercial and logical next step after animal cloning. Now, whether the public will view any form of cloned animal as genetically modified food, or whether the current proposals will open the door to transgenic cloning, is open to question. Either way, public perceptions of GM foods are a relevant consideration.

Since 1996, the series of Eurobarometer surveys on biotechnology has included a knowledge quiz. This comprises a number of factual questions and a further three questions that tap into what have been called menacing images, derived from focus group discussions with members of the public. The three image questions are as follows:

Table 1: Menacing images of genetic modification in Europe

Question	% agree EU 25	Highest % in any EU country	Lowest % in any EU country
Ordinary tomatoes don't have genes but genetically modified ones do	36	55	23
By eating a genetically modified fruit, a person's genes could also become modified	23	43	9
Genetically modified animals are always bigger than ordinary ones	27	57	11

Source: Eurobarometer 64.3: Biotechnology in 2005: Patterns and Trends

While agreement to these propositions may indicate an absence of knowledge about genetics, it also shows anxieties about adulteration, infection and monstrosities. Such concerns echo the idea of magical thinking, described by the anthropologist Frazer[25] and more recently Rozin[26]. For example, and paralleling question 2, the consumption of chicken slumped for a time when people heard that bird flu had reached Europe even though one cannot catch bird flu from properly cooked chicken. This is an example of the law of contagion, the transfer of essences, 'once in contact, always in contact'.

That about 25 to 35 per cent of Europeans (see table 1) assent to these menacing image propositions does not necessarily mean that they all held such views before being asked the question in the interview[27] [28]. In all probability many would not have come across the issue before. But when the question is posed, people try to make sense of it. Perhaps a combination of their anxieties about the technology in general, worries about food in particular and magical thinking lead them to assume the worst.

In summary, this review of Eurobarometer surveys shows that:

(1) applications of biotechnology involving cloning are not met with enthusiasm in many European countries, even though these applications promise medical benefits

(2) producing meat from cell cultures attracts little support

(3) a sizeable minority is inclined to associate genetic modification with adulteration, infection and monstrosities.

Taken together, and the likelihood that many will assume that cloning is another form of genetic modification, these lines of evidence are suggestive of the likelihood of a negative reception for animal cloning for food products.

United States

Over the last fifteen years the American public has a more positive perception of biotechnology in general than the European public[29]. A survey, conducted by Texas A&M University, based on the 1999 Eurobarometer, revealed that some 52% of the US public held the optimistic view that genetic engineering "would improve the quality of life"[30]. The comparable figure for Europe was 41%. These high expectations in the US are confirmed in a time-series study conducted by International Food Information Council[31]. This shows that, since 1999, between 59% and 64% were of the opinion that biotechnology would provide them benefits within a five-year timeframe. It should, however, be noted that these relatively high expectations had decreased from 78% in 1997.

However, the IFIC survey also shows that the US public is cautious about the use of animal biotechnology in agriculture: in 2005 27% were in favour; 32% were not in favour; 10% neither favourable nor unfavourable; and 30% did not express an opinion.

Ambivalence about animal biotechnology is also reflected in US opinion towards the cloning of animals. In 2005**,** 74% were not in favour and only 15% were favourable (10% answered "neither nor" and 2% "don't know"). In a follow-up question, respondents were asked how likely they were to buy food products from cloned animals if the Food and Drug Administration (FDA) decided that they were safe to eat. Two-thirds (64%) stated that they were unlikely to buy such products, and one-third (34%) said that they would be likely to do so. In the same year another study by KRC Research finds that one third of consumers said they would buy meat and milk for the off-springs of cloned animals; a third said they would consider it and the final third said they would never buy such products. Taken together the IFIC and the KRC studies show that US public has yet to come to a firm opinion.

Hallman and Condry[32] of the Food Policy Institute at Rutgers University provide the most up to date review of US public opinion on animal cloning and food. They report that the issue is not on the national agenda, few people know much about it and that public opinion has not yet crystallized.

They find that the word cloning evokes negative images and the idea that it is "foreign, exotic, and vaguely artificial ---; potentially leading to initial feelings of discomfort that are reflected in many of the public opinion surveys". Hallman and Condry suggest that people do not feel qualified to make judgements about the benefits, risks and ethics of the technology. Rather, they expect to rely on trusted experts such as the U.S. Food and Drug Administration (FDA) to evaluate these concerns and provide both guidance to the public and regulatory oversight to the industry.

Further insights were obtained from a series of depth interviews with some 'well-educated opinion leaders'. These people did not understand the reasons (need) for cloning and voiced concerns about the perceived uncertainties and the unintended consequences of the technology. The interviewees also asked questions about who controls and regulates the technology, why they are using it, about the potential risks and benefits and showed a keen interest in the ethical, moral, and philosophical arguments related to cloning.

Hallman and Condry suggest that FDA approval and assurance of safety is likely to have a strong influence on the perceived acceptability of animal cloning but, at the same time, that the questions consumers are likely to ask will go beyond the science of cloning and include issues of ethical, moral, or philosophical reasons for and against its use.

5. Mapping the contours of food products derived from cloned animals

Sensitive technologies

Even if there is little research on public perceptions of cloned animals for food production, the evidence on other applications of biotechnology allows us to make some informed speculations. A not unreasonable interpretation of available public perception studies points to the existence of two criteria that contribute to people's judgements.[33]

(1) perceived usefulness and need
(2) perceived risk, ethical or moral problems.

Life science applications that are high on (1) and low on (2) tend to be acceptable, but those applications low on (1) and high on (2) do not attract public support. Such applications are likely to be socially sensitive.

Another consistent finding is two further scales that relate to public sensitivities. The organism scale, running from micro-organisms to humans is closely associated with sensitivity and public acceptance. Genetic interventions with higher animals and humans are widely rejected.

Micro-organisms ------ plants ------- lower animals ------ higher animals ------ humans

The area of application scale, running from medical to food, is again associated with sensitivity. On the whole medical applications of the life sciences are well supported, while food applications are not.

Medical ------ industrial ------environmental ------agriculture ------ food

On the organism scale, animal cloning for food supply sits towards the problematic end, since its object is animals. Being a food-related application on the second scale it also carries a considerable potential for controversy. Hence, taking both scales into consideration, one would expect to find farm animal cloning in food production to be controversial. Such applications can be expected to provoke public concern, that is likely to be amplified if cloning is combined with genetic modification.

Scientific denotation, public connotation

The issue here is about definitions and contested definitions. On the basis of scientific understanding decisions will be taken by regulatory authorities on what is and what is not a clone. A set of definition will be agreed differentiating cloned from conventional, possibly including a middle category of 'intermediate'. These regulatory definitions constitute the denotative meaning.

However, such definitions could be open to debate. Consider the discussion in the US over the 'organic' label for food. Initially the USDA included GM food in this category, but after public consultation leading to a many thousands of protests, GM food was subsequently excluded from the organic category.

Essentially, scientific and/or regulatory definitions providing a categorization of A and not A, may not necessarily be identical with public perceptions. And crucially, while scientists and regulators may attempt to 'control' denotative meanings, it is in the public domain that the connotative implications are developed and elaborated outside the control of science. How do these connotative implications arise?

As an example of the issue of categorization, consider the following scenarios:

1. Cloned cattle into the food chain

2. One cloned male parent: cloned bull – conventional or IVF breeding – leading to progeny for the food chain.

3. Two cloned parents: a cloned bull and a cloned cow – conventional or IVF breeding – leading to progeny for the food chain.

4. Any of the above with genetic manipulation.

How will these scenarios be described? Scenario (1) like Dolly the Sheep is likely to be deemed a clone. In reality the cost of cloning probably militates against this method and cloned animals will be used largely for breeding purposes. Hence scenarios 2 and 3 are more plausible origins of cloned meat. Now the question is whether these will be deemed clones or not. Viagen, a US company that offers cloning services, describes them as "like later born identical twins"[34]. Whatever scientists and regulators decide, on account of the unnatural parentage, we suspect that some in the public will lean more toward the 'cloned' rather than the 'natural' category. This hypothesis is supported by Rozin's[35] research which shows that the natural category is very delicate – any change to what is taken to be the 'natural' quickly leads to the categorization of 'unnatural'.

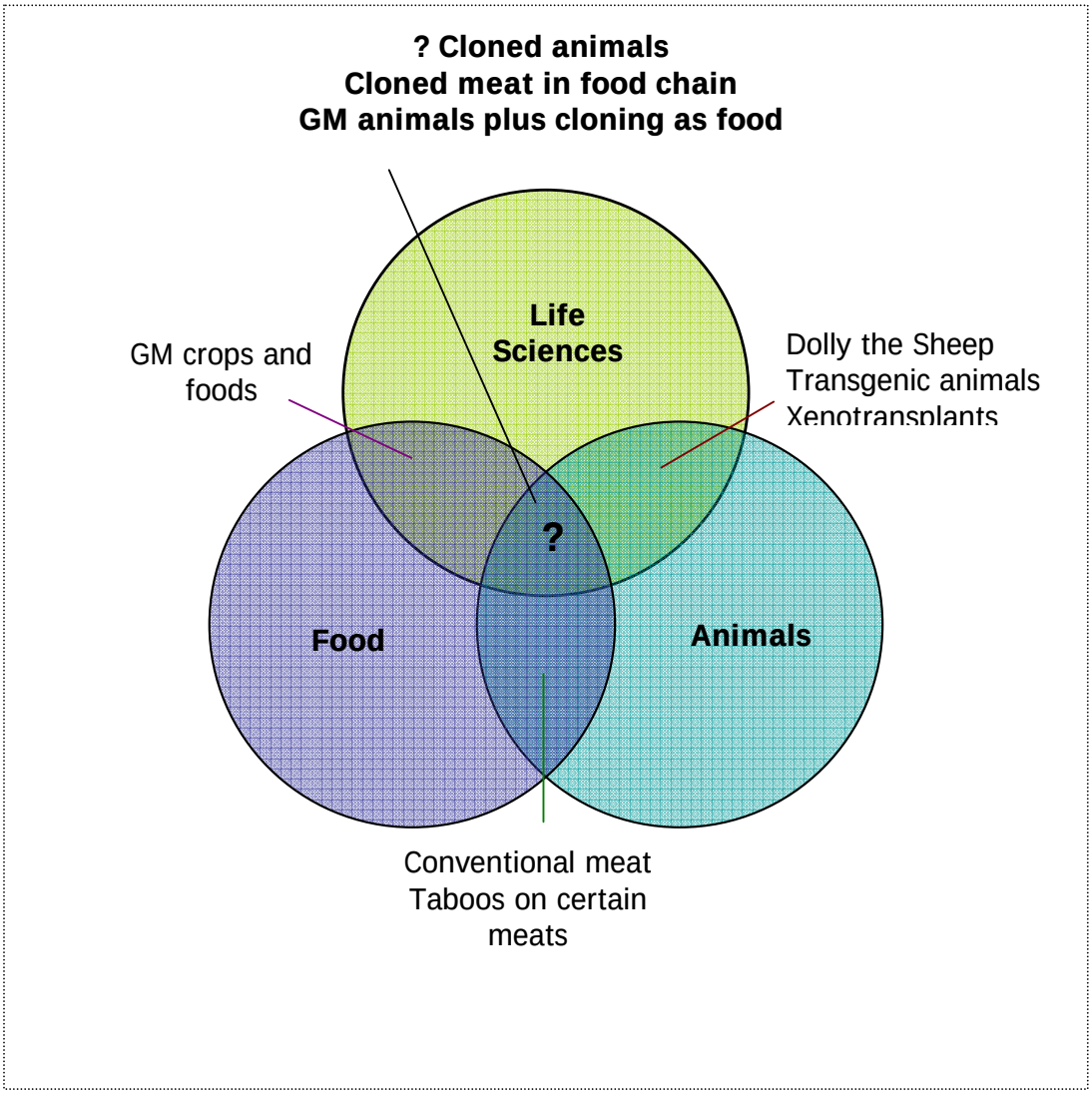
Using the differentiation between natural and unnatural to describe something that is new and unfamiliar is an example of anchoring, a key process in everyday sense-making[36]. Confronted by 'cloned meat' people will ask "what is this all about, what does it mean?" This is a question for interested individuals but the outcome is the result of a social process in which the mass media, opinion leaders and others contribute in the collective search for meaning[37]. One key process in making sense of innovations, new developments in technology, food etc, is the linking of the unfamiliar to things that are familiar. This is a public form of substantial equivalence. X (the new) is like Y (something familiar), and because X is like Y then the attributes (connotations) of Y can be attributed to X. This process is called anchoring. The key question is what familiar things (Ys) will be associated with cloned meat and whether these associations will be positive or negative.

It is important to recognise that the choice of anchors for cloned meat will be contested. Claims will be made by regulators, the cloning companies, farmers, supermarkets, consumer groups, animal activists and relayed to the public through the media. The debate will be both national and international.

Intersecting domains

However diverse anchors might be, there are three domains that are particularly likely to provide relevant anchors. These are ideas and assumptions about (1) animals in general, (2) about meat and food, and (3) about the life sciences and its techniques. In the following, we will consider these three ideational fields and how they may overlap. At the centre of the diagram at the intersection of food, animals and the life sciences is animal cloning for food supply, with the prospect of genetically modified animals as a precursor to cloning in the future. Figure 5 maps out the environment of animal cloning.

Figure 5: Food, animals and the life sciences



Life Sciences

Some technologies are more sensitive than others. The dark blue circle is the domain of the life sciences, a strategic technology that developed out of the discovery of rDNA in 1970s. The last 35 years have seen an increasing pace of discoveries with applications extending across the medical, industrial and agricultural sectors. Because the research material of the life sciences differs from other technologies in that it deals with *living nature*, i.e. in addition to human technological intervention there is organic change, the life sciences are de facto sensitive. Such sensitivities are accentuated as the outcome of interventions into life – at least in the public view – are less predictable, bringing about unknown risks, delayed and possibly uncontrollable effects[38].

Of course, cloned meat could be anchored in other modern technologies such as nanotechnology that so far has not met with particularly high levels of controversy. However, while technologies such as nanotechnology transform materials and physical matter, the life science's successes and promises arise through the transformation of 'life' – micro-organisms, plants, animals and humans. As such, perception studies suggest, that for some people the life sciences challenge basic assumptions, religious credos and social values concerning identity, dignity and the natural order. Applications such as embryonic stem cell research, transgenic animals, and cloned animals all touch upon sensitive issues.

Animals

The pale blue circle is the domain of animals – living nature in all its many forms from wild to domesticated animals. Farm animals bring into play issues of animal ethics seen in concerns about the rearing of veal calves, battery hens and deep litter pigs. The moral status attributed to animals is different from that of inorganic materials. As pointed out above, lying behind people's perceptions and judgement of applications of biotechnology there is a scale of sensitivities from human applications (most sensitive) to micro-organisms (least sensitive), with animals being situated towards the more sensitive end of the scale.

Food

The yellow circle is the domain of food**.** Here EFSA, national risk assessment bodies and European and national risk managers are the custodians of science based food safety. But, for the public as argued in the introduction, food is more than a matter of safety and fuel, the intake of non poisonous calories. The production, preparation and consumption of food are replete with historical, cultural and social significance. Food is a new source of anxiety, in part because people worry about additives and other contaminants, but also because crises such as BSE and other food scandals in Europe have challenged people's assumptions about trust in the food chain. Reflecting a greater awareness of the links between food and health and concerns about environmental issues, there is a growing interest in natural and organic food and in the vertical integration of the food chain, food miles, and the Third World.

Food and Animals

While meat is at the centre of many European cuisines it is also associated with particular social and cultural sensitivities. Science based food safety regulation cannot account for religious taboos (Jewish, Muslim Christian and Hindu) or societal preferences, vegetarianism, the probable unpopularity of the 'real dog' hotdog in America, or the near taboo on eating horse meat in the UK. The food domain provides a rich array field of possible anchors for animal cloning. Positive anchors could be conventional meat but with enhanced quality and better taste; another might be healthy meat, in that cloned meat might offer those who enjoy steak the opportunity to worry less about cholesterol. Furthermore, cloning animals might be anchored as just another method of breeding animals. On the other hand negative anchors abound – GM food, rBST, the Belgian Blue scenario that cast a pall over GM food in Sweden[39], and other food scandals. It is noteworthy that both food taboos and food scandals are more often than not related to meat. The reverberations of BSE in meat and dioxins in chicken in the 1990s, for example, continue to challenge trust in some of the links in the food chain.

Food and the Life Sciences

In the context of food, as evidenced by the Eurobarometer surveys, the introduction of genetic modification has not met with public support. The negative views of GM food expressed in these surveys has been matched both public and consumer resistance in a number of the European Member States. In recognition of public resistance 2001/18/EC and later 1829/2003/EC set out a new EU regulatory regime for the commercialization of GM crops and food – establishing a threshold for GM, requirements for labelling, new risk assessment procedures for the provision of independent scientific advice regarding safety, public consultation and provisions for ethical review[40]. But these well motivated ex post procedures have echoes of bolting horses and locking stable doors – as seen in the continued controversy over the approval of GM crops, the one million signatures in favour of labelling products derived from animals that have been reared on GM feeds, and debates about national policies for co-existence of GM, conventional and organic agriculture.

As outlined previously the Eurobarometer surveys show that a significant minority entertain menacing images about the capacity for GM to lead to adulteration, contamination and monstrosities, echoing the work of the anthropologist Frazer who wrote on magical thinking, captured in the phrases – 'you become what you eat' – 'once in contact always affected'.

With the natural superiority of the natural, GM food was categorized as unnatural. And as unnatural GM engendered a set of dystopian visions about the risks of the unknown. The putative benefits were not considered plausible to Western Europeans for whom food is plentiful and of good quality. Those arguing that GM food would solve the problem of third world hunger were not believed.

Animals and the Life Sciences

As we have seen from the review of the Eurobarometer surveys, GM animals are seen to be a societal risk, to be morally unacceptable and, as such, many Europeans are not prepared to support such developments, even with the prospects of medical benefits. The combination of genetic modification and living things not far removed from humans on the dimensions of life forms, creates particular sensitivities. Public resistance suggests a non-contingent moral argument. It is not a matter of trading off the risks and benefits; rather GM animals are in principle a step too far; they challenge the moral order and should not be countenanced under any circumstances.

Unknown territory: food, meat and the life sciences

In the middle of the graphic we find the intersection of food, meat and the life sciences - the near reality of food products from cloned animals with the further prospect of food products from GM cloned animals. On the basis of the evidence reviewed in this paper we conclude that this is likely to engender a variety of extra-scientific concerns reflecting the intuitive mentalities of the scientists, the politicians and the ethicists. These we will call 'other factors'.

6: 'Other factors', knowledge and consensus and public consultation

Public ethics

Lying behind public perceptions are a deeper level of representations or images. These comprise hopes, fears and expectations that come to people's minds as they think, read and talk about things like a socially sensitive technologies. The importance of these imaginations lies in their role to go beyond a given reality. As described above, they look backwards – anchoring or giving meaning to the novel and unfamiliar by reference to past events, objects and experiences. They also look forward to anticipate whether a socially sensitive technology suggests a negative or a positive future. Judgements about the past and future bring into action social values – normative positions on what should and should not be done – this is what we mean by public ethics. In the case of socially sensitive developments in the life sciences – the science of life itself – the importance of individual and collective values/public ethics can scarcely be exaggerated.

In the following, we assume that everyday people do consider scientific risks, but also pose a number of additional questions in evaluating modern technologies that eventually may function as vetos.

Veto 1: Risks, benefits and need

It often baffles those involved in public health regulation that people don't worry about mobile phones (the risks of which are uncertain but widely debated), but at the same time worry about GM foods. Key factors determining the differential public response is the public's *perception of benefits and need*[41].

On the one hand mobile phones are seen to be very useful, the user's family and friends gain unequivocal personal benefit. While GM food had benefits for the industry and farmers, for the consumer the benefit was not self evident. Second, there is no alternative on offer that achieves the communication advantages of the mobile phone. But with GM food many people believe it is unnecessary, as conventional food is plentiful and of good quality. The same is not true of medical applications of biotechnology. Here the risks are accepted as it is presumed that there are not alternative ways of saving lives or curing diseases.

To cut a long story short, a prime question will be whether people will perceive cloned meat to be useful. Since the question touches on sensitive moral issues, the innovation will need to be seen as bringing some *relative advantages to the status quo*, i.e. it must be perceived to be better than already existing forms of meat production (there must be a *need* for such innovation). And being useful has to extend beyond beneficiaries in the agricultural industry - it needs to bring benefits to ordinary people. Now meat is not in short supply in Europe, people can choose from different kinds of meat and meat qualities and meat is not particularly expensive. In this context it may be difficult to produce convincing arguments for the a relative advantage to the status.

On the other hand, however, with applications of cloning for medical purposes, public judgement is much less predictable, since it largely will depend on the existence of alternatives, and on perceived usefulness. Here it can be anticipated that applications that can be categorised as more efficient replacements of traditional technologies to produce medicine will largely will be rejected; whereas applications that represent an opportunity to produce a new medicine or novel type of therapy will be greeted more positively.

Veto 2: Choice and labelling

In addition to the issue of benefits and need, there is the issue of choice. People decide for themselves whether to use a mobile phone, but GM food was perceived to have been thrust upon the consuming public without the opportunity of the 'exit' strategy – deciding not to consume them. Research shows that people are prepared to accept far greater levels of 'voluntary' risk than 'involuntary' risk[42]. An important question in the context of cloned meat consequently will be whether people will be able to choose whether they eat or do not eat cloned meat.

However, labelling has its own problems as there is apparently no scientific test that would distinguish cloned meat from conventional forms of meat production. Traceability is another option but would be costly and unwelcome to farmer and food retailers.

While a number of influential voices argued that the labelling of GM food pandered to pressure group mis-information and public hysteria, its adoption in the context of EU regulatory framework on GM foods and products may well have created expectations that will also apply to animal cloning in food production. In this context it is noteworthy that informing the consumer is one of the mainstays of consumer protection legislation. Post BSE, such transparency has been a key principle of the EU policies for food safety.

Veto 3: Fairness and distributional issues

Everyday people not only will ask whether there are risks and benefits, but also whether risks and benefits are distributed in a fair way. More specifically the following questions might arise:
Who profits - Does society need this? Whose interests are advanced by cloned meat? Are there substantial benefits for ordinary people?

- *Who is at risk* - Who might suffer from possible (health) risks?

- *Possible victims* - Are there vulnerable groups (e.g. animals, children, religious groups, future generations, etc) that deserve consideration?

Veto 4: Responsibility in dealing with uncertainty and morally sensitive issues

Are the actors in charge of dealing with the technology (scientists, industry, politicians, etc.) perceived to deal with the issues in a responsible way? That is, is animal cloning in safe hands? Relevant aspects in this domain might be:

- *Unknown risks* - Is there the possibility of new and, as of now, unknown risks; what measures are being taken to address these? How are activities in the domain of cloning animals regulated? Is misuse possible?

Veto 5: Values and representations of nature and life

Are familiar and emerging technologies seen as in accordance with or in opposition to important values and ideas about nature and life (as it should be)?

- *You are what you eat* - Besides health and safety concerns, associations and meanings attributed to cloned meat will be crucial, at least for some part of the population. People want to perceive what they eat as good quality produce.

- *The unnatural argument* – There is a tendency to prefer the natural over the unnatural (as Claude Fischler observes there is a "natural superiority of the natural"[43]), a preference that is of special relevance in the food domain. Frequently, such purity concerns are not well articulated but expressed by notions of disgust and revulsion. There is the possibility that people may perceive cloned meat as unnatural.

- *The natural order argument* - In terms of the natural order there is a hierarchy spanning micro-organisms, plants, lower animals, domesticated animals, primates and humans. Progressing through this hierarchy we see the emergence of concepts of identity, dignity and rights. Hence, the question is whether animal cloning crosses a boundary of acceptable intervention. While the public are relaxed about microorganisms, concerns are expressed about GM food and about applications of biotechnology that involve animals (Dolly, xenotransplantation).

- *The slippery slope argument* – If animal cloning is allowed, what next? This idea was frequently heard in the context of the Dolly debate. Cloning animals was then feared as another step towards cloning human beings.

- *Cultural and religious constraints* - Will animal cloning be an affront to certain religious and other groupings in society (animal-rights activists etc.)?

Knowledge and consensus

In the context of social values, risks and uncertainty Douglas and Wildavsky[44] suggest that risk should be understood as a combination of knowledge and consensus on desired goals. The following table shows the proposed typology of risk problems by Douglas and Wildavsky and extends it by two further cells (5 and 6).

Table 2 Typology of Risk Problems

		Knowledge secure	insecure
Consensus on goals	given (positive)	(1) Problem: technical Solution: calculation	(3) Problem: knowledge Solution: research
	not given	(2) Problem: disagreement Solution: coercion or discussion	(4) Problem: knowledge & consensus Solution: ?
	Given (negative)	(5) Problem: taboo Solution: ban	(6) Problem: knowledge & taboo Solution: ban

(1) the risk problem is technical in nature and can be solved by calculation. Secure knowledge thereby implies that all possible outcomes and their probabilities of occurrence are known. e.g. speed limits for traffic, alcohol intake.

(2) If knowledge is secure, but consensus on goals is not given, the problem is disagreement and can be solved either by discussion or by coercion. People do not quarrel about what possible outcomes are, but on what outcome is most desired. The disagreement is on how to *evaluate* the consequences. This problem is mainly moral and political in nature, and depends on values and worldviews. e.g. abortion and surveillance.

(3) If consensus is given but knowledge is insecure, the problem is a lack of knowledge that can be solved by further research and investigation. This kind of problem is addressed by expected utility theories. Similarly, biotechnology's proponents mostly define the controversy on biotechnology as a problem of this type. Frequently it is assumed that the goal definitely is a good one but that the problem is insecure knowledge about whether the goal can be reached or not ('riskiness' in this sense is understood as probability). e.g. new drugs.

(4) If there is a lack of both knowledge and consensus, the problem is most complex and no simple solution is available. Considering the manifold views of different stakeholders of biotechnology, risk management of this large-scale technology must be seen as such a complex problem. Different social groups disagree on what the most important goals are, and knowledge about future effects is (yet) unknown. The disagreement on goals necessarily involves moral conflict. In recent years, bioethics committees in different countries have recommended differing 'solutions' for the same problems[45]. e.g. embryonic stem cell research; what about cloning animals?

(5) If there is consensus in a society that values are negative (in fact, these are "non-goals" or goals to be avoided), then such endeavours are tabooed. In this case, to talk and think in terms of risk is inappropriate – a category mistake - not allowed. e.g. we do not talk about taking the risk of eating our dog or our neighbour, or committing incest. Such things are linked to ideas of sin, taboo or crime rather than risk. The logic of a threshold of acceptable risk is not accepted, whatever the benefits are and however small the risk is, cannibalism is just prohibited. Any departure from the norms would evoke moral intuitions and moral feelings of anger, disgust and contempt and the perpetrators would be seen as either mad or bad.

(6) In addition to a taboo there may be insecure knowledge, e.g. human reproductive cloning

It should be kept in mind that problem definitions can change: a topic can change from one quadrant to another over time, when new knowledge comes available, when cultures meet and mix, when formerly upsetting ideas become normalised, when there are new technological options etc.

Public consultation

As argued above, in some contexts, solutions to problems with a technological controversy can be solved by expert calculation or further research. Here the *intuitive scientists* will be content with such a technocratic solution. But where values are at stake and where these values are contested, mechanisms to understand and to manage diversity are required. Since contemporary liberal societies are characterised by a diversity of values, it has to be appreciated that consensus may not be possible – a general election always creates winners and losers. With respect to controversial technologies the first requirement is to understand the various positions taken by the public's intuitive politicians and intuitive ethicists.

This was recognised in the 'Science and Society' movement in the 1990s and included in a number of European Directives. Concern about the lack of public trust in science and in regulatory instruments led to a realisation that greater public involvement in science and technology policy is desirable. Attempts at public engagement include various tools of participation, designed to allow (at least some of) the public voice(s) to be heard[46]. But having heard the voice the next question is how that voice is embraced within policy deliberations.

To help to clarify the outcomes of any exercise in listening to the public voice, consider the following types of dialogue between A (the decision taker) and B (the embodiment of the public voice who is influenced by A's decisions but has little power).

Type 1: In the extreme case, there is the *non-dialogue*, A ignores B and decides independently. We then move to two types of dialogue which lead to the same outcome as the non-dialogue.

Type 2 A acknowledges B, but since A thinks B is ignorant and uninformed, A ignores B, *the technocratic style.*

Type 3: A acknowledges that B is ignorant and tries to inform B while deciding autonomously, *the public relations approach*.

Type 4: Here we see the emergence of a form of real dialogue. Here, A listens to B but does so in terms of A's definition of the problem and its possible solutions. B's view is heard only in so far as B talks in terms of A's definition, *the sound science approach*. In all these forms of (non-)dialogue, B will not feel committed to its outcome.

Type 5 constitutes a genuine attempt at *public consultation*. A has a 'position' but tries to understand B's viewpoint on the issue. A is willing to learn from B and to accommodate to B, i.e. A is prepared to modify his/her position, and B understands this is part of the social contract. A takes the decision and in a public record makes the criteria explicit and, if B's position is rejected, explains the reasons for the rejection.

In the sense of type 5, meaningful consultation implies being heard and being taken seriously and, if a viewpoint is not accepted, hearing why. It implies a commitment of time and patience on the part of the decision taker to listen to a range of viewpoints, preparedness to accommodate the views of others and public accountability through publicly recording the basis on which the decision was made and the reasons for rejecting certain positions. And when consultation is so structured, it provides an incentive for B, the public, to be interested in science and to engage in the democratic process.

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