Transgenic plants and the management of virtual risks[1]

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Risk management involves *a balancing act* in which the potential *rewards* of a contemplated action are weighed against the potential *costs*. There has been a long-running and sometimes acrimonious debate between "hard" scientists - who treat the rewards and costs as capable of objective measurement - and social scientists - who argue that risk is culturally constructed. Much of this debate evaporates if one distinguishes three categories of risk:

- *directly perceptible risks*: e.g. climbing a tree, riding a bicycle, driving a car,
- *risks perceptible with the help of science*: e.g. cholera and other infectious diseases,
- *virtual risks* - scientists do not know or cannot agree: e.g. low-level radiation, pesticide residues, global warming.

In Figure 2 these categories are represented by three overlapping circles to indicate that the boundaries between them are indistinct, and also to indicate the potential complementarity of approaches to risk management that have previously been seen as adversaries.

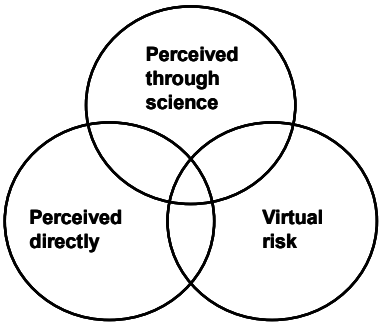

Figure 2. Three types of risk.

Directly perceptible risks are managed instinctively and intuitively. We do not undertake a formal probabilistic risk assessment before we cross the street. Other risks are only perceptible with the help of science. With a microscope, for example, one can see, and measure objectively, the agents responsible for many infectious diseases. To the extent that science illuminates for non-scientists the connections between behaviour and consequence, it shifts risks into the directly perceptible category. But there remain many risks about which scientists cannot agree. Many of the risks associated with genetic modification fall into this category. These risks relate to potential health effects, to the potential loss of control over environmental releases, and to the concentration of power over the processes and products of genetic manipulation.

Some of the risks associated with food can be assigned to the category of *risk directly perceptible*. Our senses of sight, smell and taste form our first line of defence against food that might make us ill. Putrid food offends all three senses and is

[1] This paper draws upon two earlier papers by the author: "Cars, Cholera and Cows: virtual risk and the management of uncertainty," *Science Progress* 1997, 80(3), 253-272, and "A Richter Scale for Risk? The scientific management of uncertainty versus the management of scientific uncertainty," presented to the British Association meeting on environmental risk, 10 September 1997.

rejected. Commonly the rewards are also directly perceptible; eating is one of life's pleasures and we are attracted to foods that look, smell and taste delicious. Hunger and our sense of repleteness also govern, more or less satisfactorily, the quantities we consume.

Science also plays an important role in what we eat. Folk science, in the form of accumulated knowledge about which plants are poisonous, or curative, has assisted direct perception for many millenia. Increasingly the range of direct perceptions is being extended by the printing on packaging of use-by dates and other advice relating to preparation and nutrition. Modern science in the form of knowledge about poisons, vitamins, allergies, metabolism, genetic susceptibilities etc. also guides the regulators of the food chain. But at the same time that science is illuminating, and reducing, old risks, it is creating new ones. It produces impressive rewards - in the form of nuclear power, new materials, effective pesticides, new crops etc. - but often accompanied by uncertain, and potentially catastrophic, side-effects.

We do not respond blankly to uncertainty, we impose meaning upon it. Long-running controversies about large scale risks are long running because they are scientifically unresolved, and unresolvable within the time scale imposed by necessary decisions. The clamorous debates that take place in the presence of uncertainty are characterised not by irrationality, but by *plural rationalities.* Scientific uncertainty liberates people to argue from pre-established beliefs, convictions and biases. The contending parties often argue logically, but from different premises. Figure 1 presents examples of responses characteristic of well-established biases.

- *Individualists* are enterprising "self-made" people, relatively free from control by others, and who strive to exert control over their environment and the people in it. They are pragmatic and optimistic, and tend to be more impressed by the potential rewards of genetic science and technology than by its risks. Nature, according to this perspective, is to be *commanded* for human benefit.
- *Hierarchists* inhabit a world with strong group boundaries and binding prescriptions. Social relationships in this world are hierarchical with everyone knowing his or her place. They are the regulators responsible for containing the risks associated with genetic manipulation. Nature is to be *managed*.
- *Egalitarians* have strong group loyalties but little respect for externally imposed rules, other than those imposed by nature. They are democrats who resent and fear the power of both big business and big government. Nature is to be *obeyed and respected and interfered with as little as possible.* The activities of the large bio-tech industries are resisted as *unnatural* and *disempowering*.
- *Fatalists* have minimal control over their own lives. They belong to no groups responsible for the decisions that rule their lives. The best you can do is *duck if you see something about to hit you*.

As the science becomes less certain, the importance of these biases increases. **In brief,** we live in an uncertain world, but certain conclusions about the management of genetic risks might, nevertheless, still be ventured:

- **It is important to be clear about the nature of the risk under discussion.**
- **Where risks are directly perceptible**
    - *everyone* takes risks; *everyone* is a risk manager;
    - taking risks leads, by definition, to accidents; the pursuit of world free of accidents is a futile exercise;
    - it is important to distinguish self-risk (e.g. eating too many cream buns, or beef on the bone) from behaviour that puts others at risk (e.g. unhygienic

practices on a food production line); the second is a legitimate area for regulation; the first is not;
    - attempts to criminalise self risk are likely to be worse than useless; they are likely to redistribute the burden of risk in ways that harm innocent third parties;
    - all genetically modified products should be so labelled to permit individuals to decide for themselves whether they wish to use them;
    - risk management is a balancing act; institutional risk managers who do not take account of the reasons that people have for taking risks - the rewards of risk - will be frustrated.
- **Where risks are perceived with the help of science**
    - science can reduce uncertainty by illuminating the connection between behaviour and consequence;
    - science, effectively communicated, can defeat superstition and purely imaginary scares, but
    - science cannot provide "objective" measures of risk;
    - risks come in many incommensurable forms that defy reduction to a common denominator;
    - the act of measurement alters that which is being measured;
    - risk is a reflexive phenomenon; in managing risks we are continually modifying them; in the realm of risk Heisenberg probably rules.
- **Where scientists don't know or cannot agree**
    - we are in the realm of *virtual risk* where plural rationalities contend;
    - virtual risks are cultural constructs;
    - they may or may not be real - science cannot settle the issue - but they have real consequences;
    - the precautionary principle is of no help, different rationalities adhere to very different versions of the principle;
    - virtual risks are a fact of life; science will never have all the answers;
    - humility in the face of ignorance is a precondition for civilised debate about virtual risks.

Figure 1: Ecological risks and prospects of transgenic plants: a typology of bias

😐 Fatalist

- *The whole world is powerless to countermand the actions of powerful, profit-driven corporations:* "[GMOs are] being inflicted on unwilling people like myself by Monsanto's unwelcome inclusion of GMOs in the world's food supply…. There are no benefits for the consumer by the inclusion of GMOs, only greater profits for Monsanto."[i]

Austin, *The Guardian*, 16 December 1997.

- Gallows humour is a common fatalist response to perceived powerlessness.

☹ Hierarchist

- *genetically modified organisms constitute a management problem, soluble by science and regulation*
- "We conduct a full scientific risk evaluation . Once we are satisfied, we recommend to Ministers, who have always accepted our advice and who then issue Government approval." Derek Burke, Chairman of the Advisory Committee on Novel Foods and Processes, explaining how genetically modified foods gain approval in Britain.[ii]
- "We had no safety concerns [about genetically modified soya] and the Food Advisory Committee did not require labelling." ibid
- *Government and the scientists it employs know best - but there is a risk communication problem.* "We used to think that all we had to do was to decide whether a novel food or process was safe or not, and a grateful public would accept what we said. We should have known better! Food irradiation, a process I and many others, believe to be safe is unusable because of fears connected with the word 'irradiation', which go back to the atomic bomb and are fed by concerns about nuclear power stations." Ibid

☺ Individualist

- "The new technologies are environmentally friendly and will lead to health benefits, an end to world hunger and reduced use of pesticides. 'There's no crop or person that cannot benefit. There's a tide of history turning. You can look back, or ask how you're going to feed the world,' Monsanto said."[iii]
- "Biotechnology is, and has always been, used to make bread, bacon, beer, wine, cheese, yoghurt, pickles and sauces. Humans have been manipulating plant and animal genes for about 8000 years, by breeding and cross-breeding. The difference is that, since Crick and Watson worked out the structure of the genetic code in 1953, it is now possible to work out exactly what is going on when an animal or plant grows faster, taller, or straighter, or withstands rust or blight or brucellosis."[iv]
- *if you can't prove its dangerous assume it's safe*: "Do you cease to approve all new technologies until everything you could conceivably imagine as a risk has been evaluated to the nth degree? … I am confident it is safe. It is not possible to prove that it is entirely safe." Monsanto[v]

☹ Egalitarian

- *abhors "unnatural" practices; is averse to unpredictability; fears technology dependence, and the polarising socio-economic consequences of the concentration of the ownership of the new technology in a small number of hands*
- "Robert Shapiro [CEO of Monsanto] … has to find a market for the products his company has spent billions developing … The wants and needs of ordinary humans are incidental. This 'growth at any costs' attitude on the part of the world's corporate giants is destroying not just our physical environment but the social environment that nurtures human community. … The biotech industry [seeks] to prohibit labelling of genetically modified foods. … The premium now is clearly on ignorance. … Whatever the multi-million dollar spin merchants care to tell us, the scientists cannot guarantee their results. … man's tampering with nature in this way is a recipe for disaster straight out of a horror movie. And you know what comes next. Nature fights back."[vi]
- *if you can't prove its safe assume it's dangerous:* "We cannot just release these things into the environment and hope for the best" Greenpeace[vii]

[i] Lynette Anderson, *Food Magazine*, November 1997. A true fatalist would not trouble to write to a magazine because there is no point, but this quotation exemplifies what might be termed an informed-fatalist perspective. A recent study of public attitudes in Britain to genetically modified foods discovered that fewer than half the people recruited for focus group discussions of GMOs had even heard of biotechnology in the context of food (R. Grove-White, P. Macnaghten, S. Meyer & B. Wynne (1997) *An uncertain World: genetically modified organisms, food and public attitudes in Britain*, Centre for the Study of Environmental Change, Lancaster University). Thus fatalists can be assumed to outnumber by a wide margin all the active participants in debates about GMOs.

[ii] Derek Burke (1997) The regulatory process and risk: a practitioner's view, in *Science, Policy and Risk,* The Royal Society, London.

[iii] *The Guardian*, 15.12.97.

[iv] Bernard Dixon, editor of *Medical Science Research,* in *The Guardian*, 18 December 1997

[v] *The Guardian*, 17.12.1997

[vi] Anita Roddick, Body Shop International in letter to *The Guardian*, 19 December 1997

[vii] *The Guardian*, 17.12.1997