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Expert rationalities of GM: non-GM equivalents, similar risks and different capabilities

Abstract

In this paper, I examine expert rationalities of GM in 2003 drawing upon a discourse approach. My analysis shows that a significant feature of expert rationalities of GM is to specifically relate GM to its conventional counterparts (I refer to this as an example of associative argumentation). Within this relational context, expert rationalities of GM rely heavily on the discourses that the risks presented by GM are *similar* to those presented by traditional equivalents, and that the capability of GM is *different* (that is, superior) to non-GM approaches (I refer to this as an example of switching). Within the context of regulatory review in 2003, I argue that this dominant discursive pattern serves the primary function of advocating GM technologies, and that the discourse of risk similarity in isolation serves the purpose of constraining calls for additional regulation for GM approaches. Further, I argue that while this expert rationalisation of risk might be discursively powerful, its social power is limited by its sociological naivety.

Introduction

Scientific knowledge or evidence is important to United Kingdom (UK) governmental policy-making with respect to managing the risks associated with novel and existing technologies; for example, see the web sites of the Department for Environment, Farming and Rural Affairs (DEFRA) (2007) and the Office of Science and Innovation (2007a). In such circumstances it is important to ask, *what are the rationalities of scientific experts with respect to risk and other aspects of novel technologies?*, *what are the functions or intents of these rationalities?*, and *how might these rationalities interact with broader social values?*. With these questions in mind, my objective in this article is to examine the rationalities of scientific experts with respect to GM via two examples of expert discourse in which agbiotech is broadly advocated. The first of these, based upon the analysis of interview data collected in the spring of 2003, is the informal discourse of scientists working in crop genetics in the UK. The second, based upon analysis of documentary data in the form of the two reports of the UK GM Science Review (2003; 2004), might be described as a formal, policy-embedded discourse relating to GM science.

Analytical frameworks

Prior to detailed discussions of this empirical work, I would like to comment on the analytical frameworks that are employed in this paper. My analysis of the interview and documentary data draws upon the *discourse approach* (Gilbert and Mulkay 1984; Potter and Wetherell 1987), within which discourse is considered to serve the function of attempting to reconstitute or reframe issues or debates. In addition, the analysis of discourse is regarded neither as a window on a social or technical reality (for example, in this instance, whether the risks presented by agbiotech and conventional plant breeding are similar or different), nor as a means of judging whether a rationale is right or wrong. Rather, analysis is regarded as a matter of understanding how specific discourses operate and the functions that they serve. For the purposes of this paper, I would suggest that a discourse or a number of discourses might be regarded as the expression of a rationality.

Associative argumentation has been described by Myerson and Rydin (1996 pp171-8) as,

> 'a process for fixing the terms, the issue, the fact. Association looks outwards as associative arguments place issues, facts and theories. Other reference points are used to focus the arguments and explain why this one matters. Association is therefore positional.'

Myerson and Rydin provide examples of the ways in which arguments can be made more or less persuasive by associating them, positively or negatively, with other notions, historical personalities, historical practices, policies or problems/solutions. For example, they illustrate how contrasting contemporary arguments, with respect to debates surrounding global population, can be advocated through association, positively or negatively, with the arguments of the historical figure most associated with population debates, Thomas Malthus. They go on to illustrate how the policy objective of sustainable development can be legitimised by association with other policy objectives, such as peace, democracy and human rights. Finally, they show how the approach of pollution control can be advocated by associating it with broader notions of future progress and, at the same time, pollution itself can be negatively associated with notions of regress and the past.

The notion of *switching*, on the part of scientists, is proposed by Brown and Michael (2001 p3) in the context of the rationale of pigs as the ideal donor species for xenotransplantation (XTP), 'the surgical use of nonhuman tissues, organs and cells for human transplantation'. In this work the term switching is used in a number of senses, one of which is most relevant here: in advocating the use of pigs as the ideal donor species in XTP, advocates routinely switch between rationales that emphasise the similarity and difference between humans and

pigs to advance their argument (note that Brown and Michael use the term 'sameness' rather than 'similarity'). The rationale of similarity warrants the identification of pigs as the ideal donor species on the basis of the physiological similarity between humans and pigs. On the other hand, the rationale of difference emphasises the moral difference between humans and pigs (especially when compared with the lesser moral difference between humans and other primates), and thus further legitimises the use of pigs for XTP.

While many frameworks have been proposed to analyse the relationships between science and society, for the purposes of this paper I wish to draw on two that focus on the sociological naivety or sophistication of scientists and policy-making institutions (as in Brown and Michael 2001). These frameworks are what they refer to as the *critical approach to the public understanding of science* (cPUS) account, often associated with Wynne (1989; 1996) and the *actor-network theory* (ANT) account, often associated with Latour (1983). Within cPUS scientific actors are construed as sociologically naïve in the sense that they fail to understand the extent to which their own supposedly objective knowledge is framed by values, the extent to which these values might contrast with broader social concerns and values, and the ways in which putatively universal scientific knowledge may be at odds with local lay knowledges and understandings. As Brown and Michael (2001 p4) put it,

> 'Experts are seen to assume the facticity of their (scientific *and* social) knowledge, which is actually dependent on abstract experimental and practical conditions. When this knowledge is promoted as wholly unproblematic to public groups who have counter-experiences, those publics quickly become disillusioned, withdrawing their trust.'

In contrast, ANT constructs scientific actors as sociologically sophisticated in the sense that they are able to effectively enrol or enlist other social actors into their scientific and social projects. Brown and Michael (2001 p7) put it thus,

> Scientists 'are characterised as sociologically sophisticated actors who pragmatically traverse the boundaries between scientific and social reasoning. This, ANT suggests, is not an exceptional occurrence but necessary to all instances where scientific experts are able to succeed in propagating their claims and technologies.'

The empirical material

The interview results reported here are derived from one section of eighteen one-to-one, one hour, semi-structured interviews with scientists working in crop genetics in the UK in the spring of 2003. I conducted nine interviews at the John Innes Centre (JIC), near Norwich in East Anglia, and nine interviews at Long Ashton Research Station (LARS), near Bristol in the west of England (this research centre relocated to Rothhamsted Research in Hertfordshire,

north of London over the summer of 2003). The section of the interviews from which these results are derived specifically related to GM techniques, crops and foods. In particular, informants were invited to characterise GM technologies, and to identify any particular benefits or risks associated with the technologies. Other sections of the interviews focussed on broader issues, such as the strengths and weaknesses of scientific knowledge and other forms of knowledge, the appropriate role of scientific knowledge and other forms of knowledge in environmental policy-making, and relationships between science and broader society (see Burchell 2007).

As mentioned at the outset, the documentary data that I examined takes the form of the two reports of the GM Science Review (2003; 2004). These documents were selected for analysis because they are important science-oriented contributions to the regulatory review of agbiotech that was undertaken by the UK government in the early 2000s. On the instruction of DEFRA, the broad remit of the GM Science Review was to 'review the science surrounding GM [techniques] crops [and foods], with a focus on topics shaped by public questions and concerns' (GM Science Review 2003 p7). More specifically, these topics were reviewed within the following framework,

> '(1) summarise the range, quality and degree of agreement of scientific studies that have investigated the issues; (2) ask whether the topic is unique to the processes and products of genetic modification or whether there are commonalities with crops bred conventionally; and (3) ask whether there are important scientific uncertainties' (GM Science Review 2003 p8).

The reports are largely based upon the peer reviewed scientific literature, although over one hundred contributions were also received from a wide variety of sources. The primary purpose of the second report (GM Science Review 2004), and the reason for its inclusion in this analysis, was to incorporate the results of the DEFRA-initiated Farm Scale Evaluations (FSEs) of the impacts of GM crops on farmland biodiversity. Further information is available at the GM Science Review (2006) website.

I selected these two bodies of empirical material for examination to facilitate comparison between a discourse that is informal and not embedded in policy-making and a discourse that is formal and fully embedded in policy-making. With respect to the formality of the two forms of data, it is perhaps not necessary to point out the distinctions between the highly informal nature of the discourses that emerge in the spoken interactions between interviewer and interviewee at some distance from policy debates, when compared to the highly formal discourse that emerges in a report that is central to a policy debate.

Having said this, the two bodies of empirical material can both be described as science-oriented and broadly pro-GM discussions of agbiotech that were produced within the same broad cultural context. Not surprisingly, the crop geneticists that I interviewed were broadly pro-GM. Certainly, it is the case that a few interviewees claimed to have neither pro- nor anti-GM views, but for the most part these claims were contradicted by other comments. The two GM Science Review reports are self-described as having been prepared by a panel of 'specialist and non-specialist scientists and social scientists from a wide range of backgrounds' (GM Science Review 2003 p8). However, since the panel had at least nine pro-GM members compared to just four more sceptical (but not anti-) members, the constitution of the panel has been criticised for its 'blatant bias in favour of the biotechnology industry' (Econexus and others 2003 p4). With these comments in mind, it seems reasonable to characterise both bodies of data as coming from a broadly pro-GM perspective. Having said this, examples of the emergence of more balanced views in the GM Science Review will be discussed later.

With respect to cultural context, the two categories of data are similar in the sense that they were both produced in the UK in the spring and early summer of 2003. This was towards the end of the extended period of public and political controversy, and regulatory review surrounding GM agriculture. Very briefly, in the UK and more widely, in the late 1990s and early 2000s, a series of events, as well as ongoing media and non-governmental organisation (NGO) interest, led to widespread public opposition to GM crops, and thus to the widespread food producer and retailer antipathy that is often referred to as the "GM crisis". In response, DEFRA initiated a programme of regulatory review that lasted from late 1998 to early 2004. This consisted of the two scientific activities that were discussed earlier (the GM Science Review and the FSEs). In addition, a public debate on GM crops and foods – known as *GM Nation?* – was undertaken, as well as a review of the economic implications of agbiotech[1]. In March 2004, on the basis of the various reports that were produced during the latter half of 2003 and into 2004, DEFRA (2004) made a policy announcement that Gaskell (2004) judged to render unlikely the commercial planting of the first generation of GM crops in the UK (also see Mayer 2000, Mayer and Stirling 2004, and Levidow, Murphy and Carr 2007 for more detailed discussions of these issues and activities).

[1] Further information on these initiatives, including the final reports, can be accessed at the following web sites: GM Science Review (http://www.gmsciencedebate.org.uk/default.htm); Field Scale Evaluations (http://www.defra.gov.uk/environment/gm/fse/index.htm); *GM Nation?* (http://www.gmnation.org.uk/); economic review of GM crops (http://www.strategy.gov.uk/work_areas/gm_crops/index.asp).

Expert discourses surrounding GM agriculture

The use of non-GM equivalents for associative argumentation

As previously discussed, in the discursive practice of associative argumentation 'Other reference points are used to focus the arguments and explain why this one matters.' (Myerson and Rydin 1996 p171). Despite the differences between the two data sets highlighted above, a significant feature of both was the discussion of agbiotech or GM in the context of conventional or traditional equivalents. This discursive practice can be identified as an example of associative argumentation in the sense that attempts are made to strengthen the case for GM techniques, crops and foods by specifically associating them with already existing non-GM equivalents. To use Myerson and Rydin's (1996 p171) terminology, this example of associative argumentation relies upon existing conventional techniques, crops and foods as a 'reference point ... to focus the arguments'. In this instance, as indicated earlier, discussion featured rationales of both similarity and difference between agbiotech and traditional equivalents.

In the interviews, examples of associative argumentation emerged in the context of specific aspects of GM agriculture and are discussed in more detail below. However, associative argumentation is built into the framing of the GM Science Review (2003 p8), and is formally stated as the second of the three objectives of the review: '(2) ask whether the topic is unique to the processes and products of genetic modification or whether there are commonalities with crops bred conventionally'. In addition, as is stated in the second report of the GM Science Review (2004 p6), the FSEs were conceived within a specifically associative framework that 'compared the impacts on aspects of biodiversity of herbicide regimes used on three GM herbicide-tolerant (GMHT) crops … with those used on conventional equivalent crops.'

In the following sections, I report on the dominant manner in which associative argumentation is employed within the two sets of empirical material with respect to GM crops and foods, and GM techniques. As shown in Table 1, associative argumentation is used to emphasise both differences and similarities between GM crops and foods, and techniques, and traditional equivalents. In summary, the dominant rationale with respect to GM crops and foods is that they are similar to conventional equivalents in terms of the risks that they present, and different in terms of their efficacy. Further, Table 1 also indicates that the dominant rationale with respect to GM techniques is that they are similar to non-GM approaches in the sense that they are part of a continuum, and different in terms of their

capabilities. Of course, the dominant discursive patterns that are discussed below emerged in a variety of ways and, certainly, views were occasionally expressed that contradict the dominant patterns (these are highlighted below). However, views that contradict the dominant discursive pattern were not consistently observed. Further, within the interviews, when they were observed, they did not conform to any discernible pattern that could be related to, for example: institutional context, seniority, age or gender.

Table 1. Dominant discourses with respect to GM crops and foods, and techniques, and their non-GM equivalents.

	Crops and foods	**Techniques**
Similarity	Risk/safety	Continuum
Difference	Capability/efficiency	Capability/efficiency

GM and non-GM crops and foods: similar risks

In the context of Risk and Rationalities, the most notable feature of the two sets of data was the discourse of similarity with respect to the risks presented by GM and non-GM crops and foods. With respect to crops, discussion centred on the environmental risks associated with the introduction of alien species, and had two key components to it: the potential for alien varieties to become invasive and the potential for horizontal gene transfer between alien and indigenous varieties. With respect to both of these issues, the risks presented by GM crops were consistently portrayed as similar to those presented by conventional crop breeding techniques. This discourse is illustrated by the following interview and documentary quotes:

Invasiveness

GM Science Review (2003 p13): 'Detailed field experiments on several GM crops in a range of environments have demonstrated that the transgenic traits investigated do not significantly increase the fitness of these plants in semi-natural habitats, and therefore they behave in a similar way to non-GM crops.'

LARS7 (Post doc.): 'I suppose what worries me more about developing new crops through genetic engineering or through traditional means is that you are going to get crops that are going to be much better suited to extreme environments, so they can be extremely drought resistant. … I would

worry that they were going to displace native species. … But that would be a concern with any new crop however it was, you know, produced.'

Horizontal gene transfer

GM Science Review (2003 p18): 'Gene flow is the movement of genes from one organism to another, and is something that takes place in nature all the time. … None of these mechanisms [by which gene flow occurs] is specific to GM plants; therefore a great deal of evidence from conventional agriculture is relevant.'

JIC1 (Group Leader): 'I think that the transfer of genes between one species and the next has always happened in nature anyway, so it's just not [an issue].'

With respect to foods, discussion focused on health risks and encompassed a number of issues, including: toxicity and nutrition, chemical composition and DNA, naturalness, and the appropriate regulatory regime. The following interview and documentary quotes give a flavour of this dominant discourse:

GM Science Review (2003 p10): 'The [regulatory] regime recognises that the consumption of food is not risk-free and requires any novel (including GM) food to be at least as safe and nutritious as any traditional food it replaces or complements.'

JIC4 (Project Leader): [Long pause] Well, although the [GM] techniques are new, I think the kind of questions you need to ask about them, I'm not sure that's really any different from other food products in terms, you know, of whether or not they're safe.'

LARS1 (Deputy Head of Division): There is no 'difference between sucrose, that is crystallised out of an organically grown plant [and] … sucrose that is crystallised out of a transgenic plant. … a purified recrystallised product is chemically exactly the same thing.'

GM Science Review (2003 p12): 'In GM food, the introduced DNA will have the same fate as DNA present in conventional food and will be inactivated and increasingly degraded as the food progresses through the digestive system.'

GM and non-GM crops and foods: different capabilities

The discourse of difference with respect to GM crops and foods emphasises their superior capability and efficiency when compared with conventional equivalents. Although this was a dominant discourse in general terms in both the interview and documentary material, certainly in the sense that such superiority was very rarely challenged, this discourse was not as consistent as the discourse of similarity.

With respect to crops, the discourse of difference focuses on the potential of GM varieties for increased yields, often within a more benign agrichemical regime. This aspect of the discourse of difference formed a significant part of interview informants' discussions of GM, and is illustrated by the following quotes,

> **JIC4 (Project Leader):** 'I think the benefits of crop genetics have to do with the yield and the stability of the yield. … There is the potential to provide plants which are more resistant to diseases…and the ability to maintain yield while reducing the inputs of artificial fertilizers and pesticides.'
>
> **LARS7 (Post doc.):** 'Well, I see potential benefits as farmers being able to get higher yields and possibly being able to use less land to get the same yield. I mean, I think most of the studies on India and China have shown that you can use less pesticides [unclear]. And, I mean, that's going to benefit everyone, isn't it? The environment, the farm workers and the general public because they're going to be eating crops with less pesticides used.'

By contrast, in only one interview was it suggested that the outcomes of conventional agriculture might be able to compete with the outcomes of GM techniques.

> **JIC4 (Project Leader):** 'The issue around genetic modification as a means of plant breeding is that, is the question of whether or not that will be a superior method of delivering those benefits or whether or not what people call conventional plant breeding will be just as good. I guess you'll have to come back in a hundred years time, [laughs] then we'll know, but it's very difficult to predict that.'

However, the discourse of difference emerges in a rather different way in the two GM Science Reviews. Notably, the discourse of increased yields is absent from these reports. This might be explained by a reminder that the remit of the science review was to respond to public concerns about GM technologies, rather than to review the benefits. Despite this, the discourse of beneficial difference, in terms of reducing the impacts of agrichemicals, does emerge in the GM Science Review. However, this discourse is challenged by a discourse of similarity that suggests that the risks associated with GM agrichemical regimes are similar to those related to conventional crops[2].

In contrast to the interviewees' discussions of GM crops, the rationale of difference based upon beneficial superiority was not evident in interviewees' comments with respect to GM foods. However, the beneficial superiority of GM foods is reflected in the comment within the GM Science Review (2003 p10) that the second generation of GM crops 'aim to: decrease levels of anti-nutritional factors (e.g. toxins); increase levels of health promoting

[2] Two key examples of this can be cited. Firstly, in GM Science Review (2003 p15), it is noted that GM technologies represent a speedier route to pest- or disease-resistant varieties and present opportunities for less malign agrichemical regimes. However, it is also suggested that this presents, 'strong selection pressure for the evolution/emergence of resistant *target organisms* [italics in original text] (pests pathogens and weeds) that can attack the new variety or survive the pesticide application' that is similar to conventional approaches. Secondly, it is noted that GM herbicide-tolerant (GMHT) crops offer the potential to use herbicides that are more benign than their conventional counterparts (GM Science Review 2003 p16). However, it is also acknowledged that, in common with conventional approaches, a successful herbicide strategy will always lead to a reduction in weeds and, thus, in the biodiversity that relies upon the weeds. Indeed, as GM Science Review (2004) confirms, this was the main finding of the FSEs, rather than anything specific to the crops themselves. Possible reasons for this discursive pattern as discussed in the following section.

factors (e.g. antioxidants); and modify levels of macro or micronutrients (e.g. vitamins)' compared to non-GM equivalents.

Switching between difference and similarity with respect to GM techniques

With respect to GM techniques, a discourse of similarity was strongly reflected in the interview data. This discourse asserts that GM techniques are part of a continuum with conventional modern plant breeding techniques (as well as much earlier techniques). However, the discourse of technical similarity was complemented by a consistent discourse of technical difference. Within the discourse of technical difference, GM techniques are portrayed as superior to non-GM techniques with respect to capability, in terms of what can and cannot be done, and to the understanding, speed, precision and control with which things can be done. It is notable that, while the discourse of technical similarity does not appear in isolation, the illustrative interview quotes below show that the discourse of technical difference occasionally appeared on its own.

> **JIC 4 (Project Leader):** 'I would see it [GM] as a new technique. I don't really see it as an extension of conventional breeding. I think it's a new way of doing things. … I think really it's the ability to transfer a single gene to another organism, which you can't do conventionally.'
> **LARS 5 (Project Leader):** 'No, I think it's a step change. It's probably slightly deceitful to refer to it as a continuum. The technology is so much more precise. If I said, I want to take the gene from one plant that makes one particular trait, I can just move that one gene precisely to my host. Whereas previously you did it by long-winded breeding processes, trying to cross species.'

However, more often, the discourses of rationale of similarity and difference are employed together by the crop geneticists. As the illustrative material below shows, very often informants switch between both discourses in the same exchange, or even in the same sentence.

> **LARS2 (Programme Head):** 'It's [GM] a continuation, it's just a continuation. The technology allows us to do things that have not been done in nature before.'
> **LARS3 (Programme Head):** 'I don't see it's [GM] any different from breeding. And, in fact, it has advantages in that it's far more controlled and that the changes you're making are usually smaller and can be produced in a very controlled way. It's even possible to determine where the gene that you're putting in has actually gone, and you can look at secondary effects, even that can be done now.'
> **LARS9 (Technician):** 'All we've [GM scientists] been doing is speeding up what plant growers have done for a hundred and fifty years. I don't see a big difference between what we do … and what a plant breeder does over fifty or sixty years.'

By contrast, the discourse of similarity of techniques is not reflected in GM Science Review (2003), in the sense of a continuum of techniques. However, the following quote asserts that GM and non-GM techniques are at least part of a continuum of endeavour,

> **GM Science Review (2003 p7)**: 'Ever since the beginnings of agriculture, some ten thousand years ago, people have been selecting plants to develop new crops. We now know that the process of plant breeding builds on changes brought about in a plant's genetic structure, with the information being encoded by genes. Since the 1970s, it has become possible to modify the genetic information of living organisms in a new way'

However, the discourse of difference with respect to techniques is strongly stated in GM Science Review (2003). More specifically, as in the interview data, GM techniques are portrayed as different in the sense that they are superior to non-GM techniques, in particular in terms of the range of possibilities and the reliability of the techniques. In response to publicly expressed concerns about the reliability and imprecision of GM techniques, the GM Science Review (2003 p9) makes a categorical associative statement of the superiority of GM techniques in these regards,

> 'To address such concerns it is important to place GM crop breeding techniques in the context of non-GM crop breeding methods … . Most of these so-called conventional plant breeding methods have a substantially greater discard rate. … The rejection rate is substantially higher for most non-GM crop breeding methods than it is for GM crop breeding. … All plant breeding methods, however, have unique features and the main special feature of GM plant breeding is that it allows a wider choice of genes for modifying crops in novel ways. No other plant breeding technique permits the incorporation of genetic material from such diverse biological sources.'

Functions, discursive sophistication and sociological naivety, and divergence

In response to the question, *what are the discursive practices of scientists with respect to novel technologies?*, I illustrated in the previous section the extent to which – in both informal interview and formal advisory documentation – agbiotech is consistently discussed in relation to conventional or traditional agriculture; I characterised this discursive practice as an example of *associative argumentation*. Further, I illustrated a consistent discursive practice of *switching* between discourses of difference and of similarity. The discourse of similarity emphasises the extent to which the risks presented GM and conventional crops and foods are similar. Meanwhile, the discourse of difference emphasises the superiority of agbiotech crops and (to a lesser extent) foods. In perhaps the most obvious example of switching, GM and traditional techniques are often portrayed as both similar (continuum) and different (GM is superior) in very close proximity. Results which contradict this dominant pattern were also discussed. These findings are summarised in Table 1. In this discussion, I wish to consider

several issues: the possible functions of this discursive pattern and the ways in which this discursive pattern aims to achieve these functions, the extent to which aspects of this discursive pattern might be considered examples of sociological sophistication or naivety, and the ways in which the two data sets differ.

The functions of the dominant discursive pattern

As discussed earlier, a key objective of the discourse approach is to understand the function, significance or purpose of discourse, and this was reflected in the question *what are the functions or intents of the discursive practices of scientists with respect to novel technologies?*. In the current case, two key functions of the discursive pattern summarised in Table 1 might be identified. As stated in Table 2, the primary of these is the broad-based *advocacy* of agbiotech (based upon discourses of both similarity and difference). In addition, and more conjecturally, the function of framing agbiotech with respect to debates surrounding substantial equivalence (based upon the discourse of similarity) might be identified.

Table 2. Possible functions of the dominant discursive pattern.

Function	Similarity and/or difference	Objective
Broad-based advocacy	Similarity and difference	Broad-based advocacy
Framing with respect to substantial equivalence	Similarity of risk	Minimise potential for additional regulation

Perhaps the central function of these discourses is to advocate, warrant or legitimise agbiotech. While one might generally expect scientists to warrant their own sphere of work, it is certainly possible that this function is emphasised, in this case, as a result of the controversy and even threat that surrounded the technology at the time at which the empirical material was produced. Thus, the purpose of such advocative discourse might be

construed in terms of protecting and promoting sectoral, institutional, departmental and individual interests. A sense of this concern is contained in the following interview statement:

> **JIC8 (Research assistant):** 'Now, with all the media hype etc, the funding is not coming through to fund a lot of projects like that. So, a lot of people who are funding projects which, at one time, they would have thought have humanitarian benefits, I think people are staying well clear of them because they do not want to be seen to be backing GM food/GM crops.'

The broad-based advocative function of these science-oriented discourses is achieved through the discursive practice of switching between discourses of similarity and difference. The discourse of similarity attempts to locate GM techniques within the context of traditional techniques of plant production that are assumed to have been socially acceptable for hundreds or perhaps even thousands of years. The discourse of similarity locates the risks presented by GM crops and foods within the context of the apparently similar risks presented by non-GM crops and foods, which are also assumed to have been socially acceptable for many years. Thus, it can be said that the discourse of similarity, where it is evident, attempts to serve the performative function of normalising GM technologies and their risks. Essentially, the discourse of similarity makes the case that *since you are not worried about these other similar techniques nor their outcomes, you do not need to worry about this technique and its outcomes*. At the same time, the discourses of difference make the simple assertion that agbiotech is superior to its conventional equivalents. As the interview quotes discussed earlier show, to a considerable extent, such superiority is specifically linked to Modern notions of understanding, precision, control and progress through technoscience. In essence, this discourse can be seen to make the case that *since this technique is based in science and technology, it can be relied upon to be superior to existing techniques and to produce superior outcomes*.

I will return to the issue of the social power of these discourses in the following section. However, as previously discussed, Brown and Michael (2001) argue that the discursive practice of switching between discourses of similarity and difference, is *discursively* powerful and persuasive because the discourses are mutually endorsing. In the context of their study of the candidate species debate in XTP, this refers to the way in which the discourses – that pigs are *both* physiologically similar to humans and morally different to humans (especially when compared to other non-human primates) – are more effective in combination than in isolation. The relevance of this analysis to the current case study is not hard to discern; an appeal based upon the argument that *GM will improve things, in ways that are as safe, familiar and acceptable as current practices* is clearly more discursively powerful and persuasive than either of these sentiments on their own.

As Table 2 indicates, a further possible function of the dominant discursive pattern might be identified. This is that the discourse of similarity with respect to the risks presented by GM and non-GM crops and foods can be seen to serve the function of limiting the demand for specific regulation for GM varieties, in addition to that pertaining to non-GM varieties. As was discussed earlier, at the time of the interviews in the spring of 2003, the regulatory framework for GM techniques, crops and foods was under review in the UK as well as internationally. As Mayer (2000) and Levidow, Murphy and Carr (2007) discuss, prior to this period, the regulation of GM foods relied upon the concept of 'substantial equivalence'. This assumes that GM foods are safe if they are shown to be substantially equivalent to non-GM counterparts; any revealed difference between a GM food and its non-GM equivalent is deemed worthy of further investigation. While the principle of 'substantial equivalence' has been criticised on a number of levels (see the summaries of Mayer 2000 and Levidow *et al* 2007), Levidow *et al* (2007) point out that the principle was designed with the primary intent of promoting regulatory harmonisation and trade liberalisation. This was achieved by limiting the extent to which GM foods would be subject to additional regulatory hurdles compared to non-GM foods and, thus, improving the economic environment for GM foods. The dominant discourse of similarity between GM and non-GM crops and foods, that emerges from both the informal interviews and the formal policy-embedded documentation, clearly supports the principle of 'substantial equivalence' in the regulation of GM crops as well as GM foods. Thus, at a time when the regulation of GM crops and foods was under review, this dominant discursive pattern can be seen to have the intent of limiting the need for additional regulatory hurdles for GM crops and foods. This, in turn, can be construed in terms of maximising the economic potential of GM crops and foods.

Discursive power and sociological naivety?

In the previous section, I explained the ways in which the discourses of similarity and difference might be considered to be discursively powerful or persuasive. In this section, I turn my attention to the question *how might the discursive practices of scientists with respect to novel technologies interact with broader social values?*. To put this another way, my intention in this section is discuss whether this discursive pattern can be construed as an example of sociological sophistication (as per ANT), or whether it is an example of sociological naivety (as per cPUS). It is by no means my intention here to provide a comprehensive analysis of social or public attitudes towards agbiotech and the broader issues that it raises. However, I do intend to highlight several ways in which the values that

are embedded within the discourses of similarity and difference might contrast with the values that can be easily discerned in wider social realms.

The first of these is the extent to which the discourse of difference relates the superiority of agbiotech to a core value of understanding, precision, control, capability and progress based upon technoscientific advance. However, the broader social power of this discourse is no doubt limited by the extent to which this value has been questioned by society in recent years. For example, a central theme within Beck's (1992) *risk society* thesis is the notion that society is now more preoccupied by the risks produced by technoscience than by the benefits. More specifically, Beck (1992) points out the extent to which technoscience can no longer be relied upon as a source of control and precision.

Further, the discourse of similarity – *since you are not worried about these other similar techniques nor their outcomes, you do not need to worry about this technique and its outcomes* – relies upon the acceptability of conventional agriculture and food production. However, in terms of the broader social power of this discourse, it should be noted that many features of modern, intensive agricultural and food production are not acceptable to many sections of society. These might include the effects on biodiversity of monoculture and pesticide-use, concerns about animal welfare, the health concerns associated with pesticide use and highly processed food production, and the power of food retailers (see Food Ethics Council 2001; Policy Commission on the Future of Farming and Food 2002). Finally, the social persuasiveness of the discourses of similarity and difference might be limited by the extent to which they ignore many of the concerns that novel technologies, such as agbiotech, appear to raise for many people. Crucially, while these concerns do focus on the issues of risk and safety that are addressed by the discourse of similarity, they also focus on a wide range of broader issues and questions, such as: the distribution of risks and benefits; consideration of alternatives; ethical concerns; choice and information; uncertainty and precaution; long term risk and sustainability; who has authority to decide and how does this happen?; who takes responsibility should something go wrong?; and can institutions be trusted?. For detailed discussions of these attitudes see the work of Grove-White *et al* (1997) in the UK, Mariss *et al* (2001) in five European countries, and Lassen and Jamison (2006) in Denmark.

The foregoing discussion suggests that there is a disjuncture between the values that are reflected in science-oriented discourses of similarity and difference, and those easily observed in broader society. On this basis, although the science-oriented discursive practices that I have identified in this article might be characterised as discursively powerful

in certain ways, they would also appear to be sociologically naïve in a number of ways as predicted by cPUS.

Differences in discourse

The final issues for consideration here are the extent to which associative argumentation and switching are used differently in the two data sets, and possible reasons for any difference. Of course, the language of the research interviews is less formal than that of the documentary data. Beyond this, the main difference between the two data sets is that the documentary data is more contingent than the interview material. Contingency is present in GM Science Review (2003) in three key ways. For instance, as discussed earlier, the potential for GM crops to facilitate more benign agrichemical regimes than non-GM crops is stressed in both bodies of data. However, only in GM Science Review (2003) are the problems of target organism resistance and loss of biodiversity associated with both GM crops and non-GM crops. In addition, GM Science Review (2003) is more contingent than the interview data in the sense that the problems associated with the risk assessment of GM crops and foods are given greater prominence.

> **GM Science Review (2003 p10):** 'The long-term assessment of the health effects for whole foods and feeds is considerably more difficult than the post-marketing monitoring and surveillance of a single substance such as single medicine.'
> **GM Science Review (2003 p11): '**There is an accepted approach, based on a standard set of safety tests, to the assessment of the allergenic potential [of GM crops]. But there is some contention over the value of specific tests and if, and how they can be improved.'

Finally, contingency can be observed with respect to the acknowledgement of areas of scientific uncertainty or ignorance.

> **GM Science Review (2003 p10):** 'Some reason that the absence of evidence of harm should not be treated as evidence of the absence of harm.'
> **GM Science Review (2003 p13):** 'We do not have an exact understanding of what changes in a plant's life history will affect its invasiveness. More knowledge on the potential effects of releasing GM plants with traits such as pest and disease resistance and stress tolerance is required since these may significantly alter a crop plant's ability to survive outside the agricultural environment.'
> **GM Science Review (2003 p11):** 'Our relative lack of knowledge about factors that are important in sensitisation and the elicitation of an allergic response suggests that we should continue to exercise caution when assessing all new foods, including foods and animal feeds derived from GM crops.'

A number of reasons might explain this apparent difference in the ways in which associative argumentation and switching are utilised in the two data sets. Certainly, it is possible that the interview informants, not having had the opportunity to review a wide range of scientific evidence in the way that the GM Science Review panel did, were simply not aware of some of these contingencies. It is also possible that any of the interviewees would have *written* about these issues in more contingent terms than those in which they spoke about them. However, it seems more likely that these are areas in which the four sceptical members of the GM Science Review panel were able to influence the outputs of the review. Thus, while GM Science Review (2003) reflects the same dominant discourse as the interview data – that GM represents a technology that is superior to, and presents similar risks to, non-GM approaches – some of the challenges to this discourse are acknowledged.

Conclusion

In this article, I have suggested that a significant aspect of the science-oriented advocacy of agbiotech or GM agriculture is the discursive practice of associative argumentation, by which aspects of agbiotech are defined in terms of their traditional or conventional equivalents. Further, my analysis has shown that, in common with the XTP example, a dominant feature of science-oriented advocacy of GM is the practice of switching between a discourse of similarity (which attempts to normalise agbiotech) and a discourse of difference (which endeavours to portray agbiotech as superior to conventional equivalents). This raises interesting questions concerning the extent to which such practices are typical of the advocacy of novel technologies, and the ways in which public controversy and/or regulatory review might influence such practices.

In common with the XTP example, I have suggested that such switching is discursively persuasive because it marshals together arguments of similarity and difference in mutually endorsing ways. However, although I have not undertaken a thoroughgoing review of public attitudes, I have suggested that the discourses described above also represent an example of sociological naivety (cPUS) because advocates seem to fail to account for the ways in which their values might be at odds with some broader social values. In the case of GM agriculture, this was to prove significant because public controversy largely led to the regulatory review which, temporarily at least, curtailed the commercial development of the technology in the UK. To some extent as a result of this curtailment, the OSI now advocates the use of processes of *public dialogue* to improve policy and to mitigate against controversies such as the 'GM crisis' (OSI 2007b). It will be intriguing to assess the impacts

that such processes have or do not have on science-oriented discourses relating to novel technologies.

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