COVER SHEET FOR "All things weird and scary": Nanotechnology, theology, and cultural resources[1]

Sarah R Davies
Institute of Hazard and Risk Research
Department of Geography
Durham University,
Durham, DH1 3LE, UK
sarah.davies@durham.ac.uk[2]

Matthew B Kearnes
Institute of Hazard and Risk Research
Department of Geography
Durham University,
Durham, DH1 3LE, UK
m.b.kearnes@durham.ac.uk

Phil M Macnaghten
Institute of Hazard and Risk Research
Department of Geography
Durham University
Durham, DH1 3LE, UK
p.m.macnaghten@durham.ac.uk

[1] This work has been supported by the FP6 project: DEEPEN: *Deepening Ethical Engagement and Participation with Emerging Nanotechnologies* (see www.geography.dur.ac.uk/projects/deepen) which seeks to explore the 'lay-ethical' responses to emerging nanotechnologies. We would like to acknowledge productive discussions around this topic with the other DEEPEN partners.
[2] Corresponding author.

“All things weird and scary”: Nanotechnology, theology, and cultural resources

Abstract

Nanotechnology is widely suggested to be fast becoming a defining technology of the 21st century. This ‘science of the very small’ has applications in areas from medicine to materials, and is predicted to have profound effects on social life. In this paper we draw on a study of laypeople’s reflections on the ethics of nanotechnologies to focus on the talk of one group of participants, from a UK church. While we identify key themes which are common across all participants, including nanotechnology as a threat to the human, the importance of individual autonomy, and distrust of the large-scale drivers behind the technology, we argue that the church-going group have a specific set of cultural resources with which to articulate responses to these. Using a language of spirituality and relationality they are able to express shared notions of what nanotechnology threatens (and promises), and can therefore be seen as exemplary of lay negotiations of these issues.

Keywords: Nanotechnology; Religion; Science; Lay talk.

1. Introduction

Reflecting on the findings of a 1990s focus group research project on lay perceptions of genetic engineering (Grove-White et al. 1997), Deane-Drummond and her co-authors (2003) suggest that the questions such work raises are, in many ways, theological ones. In contrast to traditional framings of public concerns about new technology, which centre on a calculation of risk and benefit, they present public controversy around genetic modification (GM), which peaked in the UK in the late 1990s and early 2000s, as fundamentally about ontological and theological questions rather than the more frequently suggested causes of concerns about risk or out-of-control irrationalism. As a development of this they argue for an increased sensitivity in research to the "quality and texture of the actual reactions of 'ordinary people'" (p.19). Such an approach remains novel in the context of research on public responses to new technologies. After a host of technological controversies, UK science policy has witnessed a renewed interest in understanding 'public attitudes' toward technologies, culminating in an official commitment to forms of 'upstream public engagement' on these matters (HM Government 2005; Royal Society and Royal Academy of Engineering 2004). However, despite high-profile public engagement and consultation exercises – such as *GM Nation?* and recent debates concerning stem cell research – official characterisations of public concerns relating to new technologies are dominated by the assumption that such concerns are irrational and personal, concerned solely with risks or benefits, and a product of manipulation by mainstream media.[i] The suggestion that public controversies have an ontological – even theological – quality and might be understood as a kind of ontological-politics (Mol 2003), contesting the very meaning of human and non-human life, therefore challenges the received understanding of the tenor of public concern.

In this paper we seek to explore these dynamics through analysis of a study focussing on another new field of technological endeavour: nanotechnology. As with the 1997 *Uncertain World* study on GM (Grove-White et al. 1997), on which Deane-Drummond et al. draw, there is currently little public awareness of nanotechnology, both in the UK and Europe and in the US (Gaskell et al. 2004; Opinion Leader 2008; Peter D Hart Research Associates 2007). The technologies which fall into it as a category (anything that involves the "understanding and control of matter at dimensions of roughly one to 100 nanometers", NNI 2004) are, however, rapidly becoming more prevalent in the marketplace, and their use is predicted by some to define the 21st century (Roco 2001). As of July 2008, the Project on Emerging Nanotechnologies' Consumer Products Inventory[ii] listed 610 products based on nanotechnology currently on the market, from sun cream to music players, up from 580 six months before. A 2007 report by the insurers Lloyds suggests that "current and potential areas of application [of nanotechnology] include transport, manufacturing, biomedicine, sensors, environmental management, food technology, information and communications technology, materials, textiles, sports equipment, cosmetics, skin care and defence" – and notes that the list is not exhaustive (Lloyds 2007).

With such diverse and potentially world-shaping applications, many have argued that nanotechnologies are likely to raise significant social and ethical questions (see Bruce 2006; Kjolberg and Wickson 2007). Whilst these include traditional risk-based concerns – particularly evident in current debates about the possible eco-toxicology of nanomaterials – contemporary scholarship has demonstrated the potential

for nanotechnology to heighten a range of broader socio-political and ethical concerns (Kearnes et al. 2006b). Recent debates about, for example, GM food, civil nuclear power and stem cell research demonstrate the ways in which technologies have the potential to become the locus for a host of concerns about the face of change, the opacity of official regulatory structures, and the potential for technologies to transgress hitherto taken-for-granted ethical and theological categories such as those between the living and the dead, the human and the machine, or the made and unmade (Jasanoff 2005; 2006; Kearnes et al. 2006a; Macnaghten 2004; 2009).

Given nanotechnology's potential to intensify these existing yet latent anxieties, the international policy consensus increasingly represents nanotechnology as an opportunity to improve technological governance, in which lessons can be learned from previous technological controversies such as GM, and where the technology can develop in 'socially robust' ways (see Kearnes et al. 2006). For example, Macnaghten et al. (2005) analyse the ways in which nanotechnology has been cast as an 'opportunity' for the incorporation of both social science and public deliberation under the expectation that this will enable the development of nanotechnology to be more successful. Similarly, Roco and Bainbridge (2001), speaking about the formation of the US National Nanotechnology Initiative (NNI), suggest that the initiative is "a rare opportunity to integrate the societal studies and dialogues from the very beginning and to include societal studies as a core part of the NNI investment strategy" (pp. 2, 10).

If such ambitions are to be realised it seems clear that lay input will be vital. Deane-Drummond et al.'s (2003) description of professionalised responses to the 'ethics' of GM notes that these frequently fell far short of the discussions of 'ordinary people' in focus groups, and this gap was, they suggest, one of the causes of the outcry that GM produced (see also Grove-White et al. 2000; Wynne 2003). In this paper we investigate nascent public responses to nanotechnology, drawing on research that deployed an innovative methodology for lay participants to develop their thinking on what might be 'at stake', ethically, in emerging nanotechnologies. The approach makes a novel contribution to research on public attitudes to nanotechnology through its focus on the underlying factors that shape public responses and the repertoire of moral and ethical narratives deployed in such sense-making: we examine not (only) the 'attitudes' created towards nanotechnology but the dynamics that shape them and the resources used to construct them (Swidler 1986).

The research was conducted through six two-stage focus groups, each convened in the North East of England and made up of between six and eight (non-scientist) participants from a range of backgrounds. Groups were selected around commonalities of lifeworld experience likely to be of relevance in creating positions on nanotechnology.[iii] The initial meetings introduced nanotechnology within the context of participant experiences of existing technologies, while a subsequent one day workshop attempted to draw out the dilemmas created by the ways in which the future of nanotechnology was being imagined within public discourse. All of these discussions were moderated by the researchers, and aimed to enable thorough and robust conversations around nanotechnology and its implications. The aim of these interventions was to identify implicit and explicit normative positions and arguments developed within the groups, and the cultural resources drawn upon to create them.

In this article we discuss, relatively briefly, some of the key narratives generated through the research process (section 3), describing the content of these. While there were strong commonalities between our six groups and the stories they told - meaning that it is possible to identify overarching narratives used by all of the groups – we also identified differences in the ways in which common stories were handled as discourse. Our main argument (section 4) focuses on one group in particular, drawn from regular attenders at a Durham church. We describe some of the specificities of this group's discussions and argue that their talk can in many ways be seen as exemplary of the themes we describe in section 3. They are, we suggest, able to articulate these stories more readily than other groups because they have access to specific resources of language: using a language of spirituality and relationality they are able to express shared notions of what nanotechnology threatens (and promises). Given that the dilemmas that technologies such as nano raise are construed, by lay publics generally, as theological in the sense of impinging upon deeply held intuitions about limits, the sacred, and the nature of humanity, it seems that those publics with ready access to theological languages may be more adept at expressing such intuitions.

We start, however, by considering briefly how recent discussions around science and religion may help frame our analysis. In the next section we describe some general theoretical frameworks as well as literature more specific to nanotechnology.

2. Theology, technology, and cultures

Deane-Drummond et al. (2003) argue, in their analysis of focus group data and the GM controversy, that clashes between expert and lay perspectives can be understood as two different "implicit theologies of the person" (p.28) running up against one another: a narrowly reductionist view focussed on consequentialist arguments; and a richer perspective which sought to examine all possible implications, in all domains, of scientific modifications of the relationships between persons and natural orders. They suggest, then, that *all* public responses, not just the overtly 'religious', can be understood as theological (and indeed that scientific and policy models can be understood in the same terms). From this they raise the "intriguing possibility" that:

> theological perspectives may now be indispensable in helping explain to largely secular institutions the sources and dynamics of conflicts now threatening to paralyse the development of what is being posited as a key technology for the twenty-first century (p.22)

It is from *religious* perspectives, in other words, that analysts may find both explanations of what is happening around 'key technologies' such as GM (and nanotechnology) and – Deane-Drummond et al. later suggest – new insights into how these technologies should be managed and developed within societies.

In the context of research on public responses to new technologies, this suggestion is both novel and provocative. Contemporary analyses of public attitudes to nanotechnology have been dominated by quantitative survey research, which purports to examine public 'attitudes' to nanotechnology while

disregarding its wider ontological and theological resonances.[iv] In this quantitative research *risk* is positioned as the key point of issue for publics with regard to new technologies, such that public attitudes are understood to be focussed on issues of safety and to involve assessments of the 'risks and benefits' of nanotechnologies (see Bowman and Hodge 2007; Peter D Hart Research Associates 2007). The broader ontological or theological dynamics of the relationship between the public and new technologies are typically neglected. Despite the novelty of Deane-Drummond et al.'s call – which at the very least suggests that religious voices may speak with wider resonances than is often imagined – there have been few attempts to integrate or even understand theological perspectives on new technologies. This is perhaps surprising given a rich body of work theorising the relationships between science, religion and secularism within particular societies. John C Caiazza (2005) has argued, for example, that in western cultures both revealed religion and scientific knowledge are being replaced by what he calls techno-secularism, through the ubiquity of 'magical' (cf Frazer [1922] 1995) and black-boxed technologies. He paints a picture of ruthlessly instrumental and utilitarian 'empty' belief systems (which might, perhaps, be compared with Deane-Drummond et al.'s description of 'expert' theologies). While largely agreeing with this diagnosis of contemporary society and its engagement with magical technologies, Szerszynski (2005) presents a rather different view of the historicity of these transitions. He argues that the clear cut distinction between the secular and sacred in Caiazza's (and many other analysts') writings is misguided: they are products of a shared culture and history, and disagreement is "less a matter of talking about different things…than it is of disagreeing *about the same thing*" (p.817, emphasis in original). Secularism, he suggests, can therefore be understood as having its own theology. For Szerszynski, given the shared history and cultural resources of both secularism and theology, contemporary technology is cast as a carrier of theological meaning, ultimately containing a promise of salvation (see also Nye 1994). Accordingly, the emergence of forms of reflexive modernity (Beck 1992; Szerszynski 2003) are characterised by a set of transformations in fact taking place *within both* religion and the technical sciences rather than a shift *from* religion to technology (as Caiazza suggests). Such changes involve a move away from "impersonal canonical meanings and toward indexical, pragmatic solutions" (Szerszynski 2005, 819). In both religion and technology, then, attention becomes increasingly focussed on the personal and the individual: what this piece of technology can do for me, now; what forms of spirituality will help me, here (see Heelas et al. 2004).

If Szerszynski's analysis is correct, laypeople's experience of technology may not simply be of it as magical but also as religious, relating to the sublime with promises of release from earthly limitations (Szerszynski 2005; 2006). This, of course, returns us to Deane-Drummond et al.'s (2003) point: public responses to new technologies are imbued with theological meaning around ontological issues of personhood, natural orders, and right relationships. Indeed, recent public engagement activities have indicated that laypeople frequently see new technologies as relating to 'the religious' (Bruce 2007). Similar arguments are made by those who understand lay negotiations of technology as drawing on contextualised cultural resources (which will often include faith backgrounds). Simpson (2004a; 2004b), for example, has described how cultural and religious practices and language provide a rich resource for individuals negotiating new reproductive and genetic technologies in Sri Lanka. He shows how particular technologies are understood in the light of stories from religious texts and normalised through this

frame, to the extent that medical authorities, in picking up on a (specifically Buddhist) language, have risked alienating those from other faiths (Simpson 2004b). Referring specifically to nanotechnology, Schummer (2006) argues that language, cultural heritage, economy, politics and ethics may all differ between (and within) nations, and that these will shape responses to nanotechnology. As an example he suggests that the Christian notion of a Creator God has shaped western critiques of science as hubristic and 'meddling' (cf Grove-White et al. 1997).

Such analyses point us to an understanding of religious activity as forming part of a cultural repertoire which can be used to make sense of new technologies. Culture, Ann Swidler writes, can be understood as "a 'tool kit' of symbols, stories, rituals, and world-views, which people may use in varying configurations to solve different kinds of problems" (1986: 273). The 'tool kits' of religious cultures thus provide a range of resources with which the unfamiliar can be negotiated;[v] the notion might, perhaps, be compared to that of habitus in the provision of largely unseen but powerful dispositions and skills.

We should note, however, that at least one study suggests that there is little difference in surveyed views on biotechnology between those who do and do not self-identify as being involved in religious practices (Levitt 2003); as we will argue later, our data also suggests common themes between those with different levels of engagement with organised religion. A (US-based) survey of research scientists and Christian pastors on views on human cloning similarly revealed strong similarities in what forms of cloning were or were not seen as permissible (Weasel and Jensen 2005). Finally, Tamatea (2008) analysed Christian websites in an attempt to understand lay Christian responses to 'GRIN' (genetics, robotics, information and nano) technologies as they could apply to developments in artificial intelligence (AI). He suggests that the discourse of the sites made use of substantive and functionalist views of what it means to be human 'in the image of God', noting that this stands in contrast to the thinking of many Biblical scholars. As Deane-Drummond et al. (2003) also suggest, then, there seems to be a gap between lay religious responses and those from professionalised 'expert' or 'official' religious groups, which is perhaps more significant than that between those with and without religious faith.

Thus such literature suggests that differences between active participants in religions and the non-religious may be less important in defining how new technologies are negotiated than differences between national cultures. Such an analysis would be supported by Szerszynski's (2003; 2005) arguments: the changes he writes about are at the level of whole cultures and can be understood in theological terms, rather than necessarily being about individuals' overt identification with particular faiths. Indeed, part of his thesis is that these categories may no longer be valid in western cultures (2005; see also Heelas et al. 2004). Instead, spiritualities of various forms are used to resource and nurture the "unique, individual, lived life" (2005, 819).

Given this, we turn now to examine our participants' experience of modern technological life and in particular their concerns and hopes about nanotechnologies. While the focus of our analysis will be the talk of the group of churchgoers, and its similarities and differences with that of other groups, we first describe key themes that arose in all the groups. We do this by briefly discussing some of the overlapping stories group talk constructed.

3. Negotiating nanotechnology: key themes in lay talk

Although the six groups were drawn from the same region (the North East of England), they encompassed a range of backgrounds and perspectives. One group was from an environmental and social activism student society, for example, while another was made up of older men who defined themselves as 'interested in technology' in some way. Despite this diversity, as with similar studies (for example Davies 2006; Kearnes et al. 2006; Macnaghten 2004; 2009), there were striking commonalities in the ways discussions crystallised and the concerns expressed about nanotechnology. Here we describe some of this key content and how it is constructed in talk; we should note, however, that in doing this we do not understand these themes as static 'attitudes' or fixed positions (see Billig 1987). Rather, they are stories that emerged at particular moments in the context of these group discussions, created through the use of sets of social, moral and theological resources (Swidler 1986). As such they were used flexibly within the groups, being modified and adapted to meet immediate argumentative purposes.

1. Threats to the human and to natural orders

Within the context of the groups nanotechnology was frequently constructed as threatening, in multiple ways, shared moral boundaries that constitute the nature and meaning of 'being human'. Such boundaries were an implicit part of an apparently given 'natural' order. Within the groups, and in the context of the drivers and purposes of nanotechnology (see below), being human was thus constructed as operating within fixed limits. Key concerns included the loss of individuality, disruption of a natural life course (birth and death), and the dangerous intersection of human life with machines.

In fact, there was a wide range of ways that nanotechnological applications were seen as impinging on our humanity – sometimes involving novel and surprising equivalences. For example, in the quote below one participant is talking about nanotechnologies that might in the future enable the 'downloading' and sharing of our memories:

> I wouldn't have a problem with it if you like- as an individual that would be fantastic thing, but I would be very uncomfortable with the- losing personal choice and losing basically my identity, and independence. To me that's just becoming a homogenous mass, and you aren't a person anymore. That to me would be an invasion of privacy I think. (Female, managers group)

The speaker is concerned that, whatever the benefits, such developments may lead to her 'not being a person anymore'. What is involved in this is multiple and overlapping: loss of personal choice, identity and independence, "invasion of privacy". Here 'being a person' is not dependent on one or two key attributes, but is rather a complex intersection of multiple properties. Similar concerns were expressed around the breaching of other orders, such as 'Nature' itself.

2. Control, drivers and power

Importantly, these stories of threatened orders emerged within, and should be understood as framed by, a web of inter-related stories about how nanotechnology is situated in and dependent on the perceived immobility of existing power structures. Discussion on the levels of funding being allocated for nanotechnology research and development led to detailed considerations of the role of finance – notably from big business and government – as a key force in shaping the technology and in pushing it in particular and questionable directions. The motives of government and industry tended to be characterised as driven by self-interest and short-term considerations and thus likely to steer the technology towards military, consumer or other applications that participants thought of as lacking genuine public value. Indeed, matters of finance were assumed, almost without question, to drive, motivate and underpin the shape and form of nanotechnology's development.

These stories of extended business and government control of and through nanotechnology were associated with a corresponding sense of public powerlessness. Participants often spoke of a threatened autonomy, a heightened lack of control and a sense of being 'kept in the dark'. For some these threats appeared overwhelming and to represent the single most pressing issue that nanotechnology presented:

> I think, for me, it's that powerlessness really. People, me, we, probably feel quite powerless to actually make any difference to what's going to happen. Because a lot of it has already been happening - as we see from the charts and things - whether we will have, be able to actually have any impact at all. But also transparency as well. Very few of us have been aware of what has been happening... (Female, churchgoers group)

Here one woman is summing up what has struck her most through the discussion: personal powerlessness and a lack of awareness as to "what has been happening". She expresses this in terms that are almost hopeless, reflecting that the group *had* no knowledge of developments in nanotechnology – implying secrecy on the part of the developers – and that, even though they know now, they have very little chance of having any impact on "what's going to happen".

3. The importance of individual autonomy

This point is especially striking given that a further key theme within the discussions centred on the importance of individual choice and self-determination as a key ethical principle. Sometimes this was framed as being about consumer choice; most often, however, it was expressed as an awareness of a multiplicity of perspectives and the sense that it would be wrong for any one individual to dictate particular ways of behaving to others. In the quote below, for example, a participant reflects that different people will hold different opinions on the issues that nanotechnology presents, concluding that "everyone will draw their own lines":

> Because some people would say if you're going to have a child that is perhaps slightly deformed or slightly disabled, some women would jump at the chance to have an injection and their baby to be born normal. Some would say well no, this is my baby, this is fate, this is what I, you know, I will bring that child up and raise it to be a normal child. Everyone joins a line, everyone will draw their own lines, I think. (Female, natural health group)

4. Consumption and seduction

We have noted that money and commerce were seen as key drivers of nanotechnology; as a corollary to this, consumption practices and desires were seen also as important in driving and shaping the technology's future development. Consumption practices, especially those focusing on what were seen as superficial and unnecessary consumer products for the west, were often contrasted with 'good' or 'ethical' ways of using nanotechnology. These narratives were also related to perceptions of powerlessness, with groups talking of an economy of needless consumption being foisted upon them by powerful economic interests and dominant social norms. While groups were critical of such norms, at the same time they acknowledged their power and seductive appeal:

> Whatever they throw at us we'll all have it. So it's just finding more new things to sell. It's quite divisive. It's just more and more that we want- different things that we want and the people who have it are those who can afford it. It's divisive in terms of individuals, communities within a country and internationally. (Female, churchgoers group)

The speaker here seems torn between two perspectives. She is critical of the division arising from a consumer culture in the creation of social rifts between those who can and cannot afford products, but at the same time she identifies the publics involved (herself included) as complicit, in tending to accept what is 'thrown'. These are things that are, ultimately, 'wanted' – even if, as another participant went on to point out, they are not actually 'needed'.

We noted earlier that the narratives we have described – whether those of natural orders or of individual consumption – should not be understood as fixed or stable. Inevitably our description of key themes has simplified the complexity of real-life talk, ignoring the fact that positions shift and change, stories are modified, and narratives combine and overlap. In particular we should note that, in describing coherent, if inter-related, stories, we smooth over the considerable difficulties that occurred at times within groups in articulating and expressing reactions to nanotechnology, as well as the varying resources brought to bear in constructing these explanatory narratives. It is this notion – of resourcing the expression of shared values – that we develop in section 4.

Before moving on, however, we wish to make three points with regard to the lay negotiations of nanotechnology we have described.

Firstly, we might suggest that there is a cross-cutting theme, within the stories characterised above, of lay *ambivalence* to nanotechnology. There is no straightforward weighing up of 'risks' and 'benefits' and coming down 'for' or 'against'; instead, our participants show enthusiasm mingled with concern and tempered by a detailed awareness of the real-life situations in which nanotechnologies will be enacted.

Second, we might also helpfully compare our findings with those described by Deane-Drummond et al. (2003, drawing on Grove-White et al. 1997) on lay discussion of GM. There are striking similarities. They sum up by arguing:

> First, people appeared to be responding from within a sense of a given *order* – a *natural* order, the boundaries of which were felt to be challenged radically [by GM]…
> Yet secondly, there was tacit acknowledgement that human beings might be *justified* in certain circumstances in creative interactions (interference) in such *order*. But this should only occur if the purposes were somehow the *right* ones – which appeared to mean, governed by genuine compassion and charity to other beings…
> However, thirdly, such a condition was felt unlikely to be met. There was a recurrent fatalism and cynicism about the prospect of modifying the momentum of GM developments… (Deane-Drummond et al. 2003, 26, emphases in original)

In both sets of data – on GM and nanotechnology, collected over ten years apart – we find similar concerns: the challenging of natural orders, the necessity of right purposes, cynicism and distrust of those driving developments, a sense of personal powerlessness. We will return to these similarities (and perhaps *intensifications*) as we conclude, in section 5.

Finally, we might note that the narratives we have identified all have strong moral and ethical dimensions and can – as Deane-Drummond et al (2003) and Szerszynski (2005) suggest – be understood as pertaining to the theological. Talk about a sense of threatened humanity, for example, points to notions of right and wrong forms of intervention in the limits of humanity and the sacrality of particular ways of being human. Discourses of the ethically dubious drivers of nanotechnology suggest other principles that should be applied to technological development. Given this seems to be true of public accounts of nanotechnology *as a whole* (and, given Deane-Drummond et al's analysis, of technology more broadly), what might this mean for analysis of the talk of the explicitly religious? In the next section we explore this question, focusing our analysis on one focus group – composed of attenders of a single church – in particular.[vi] We argue that this group, because of their religious affiliations, had access to a particular set of linguistic resources which helped them to articulate responses to nanotechnology which were themselves, however, not unique to this group but based on values and concerns more widely shared across other group discussions. In Swidler's (1986) terms, their cultural 'tool kit' contains specific elements which could be readily accessed and used in discussions of nanotechnology. Using a language of spirituality and relationality they were able to express shared notions of what nanotechnology threatens (and promises); notions which, as this section has indicated, were common to all groups, but which were in practice frequently hesitant, implicit, and incompletely articulated. This group, we suggest, can therefore be seen as exemplary of lay negotiations of these issues: using language drawn from Christian belief, they were able to express what at times other groups found difficult to articulate.

4. Religious affiliation and linguistic resources

We start by giving short overviews of the participants, the progress of this focus group, and the group's discussions during the one-day workshop. Before we do this it is important to note that while we are focussing on the linguistic resources participants' religious affiliations provided them with, this was not

the only identity taken up during discussions. As with all of the groups, participants made use of different roles and identities at different points of the conversation, as well as particular group identities being created during the course of the discussion. In this group, individuals made use of professional, generational and geographical identities as well as that of 'Christian'.

The group was made up of eight participants (numbers fell to seven for the workshop), with an age range of 30 to 80, recruited from a single Anglican church which described itself as 'open evangelical'. Within an initial evening focus group, discussion focussed around a number of topics: consumption and marketing, de-humanising tendencies of nanotechnologies, lay lack of control and the importance of choice, and uncertainties and dangers. As section 3 has described, none of these were unique to this group. After this session, participants were encouraged to do their own research on nanotechnology before the workshop, four days later, at which discussion continued and the group developed a short presentation based on what they saw as the most pressing ethical issues raised by the technology. In the workshop the group continued to focus on issues of de-humanisation (though also touching on others, such as military applications and uncertain side effects and dangers). Though their presentation showcased a range of perspectives, the final vision was pessimistic, an effect which was heightened by the final part of the performance: a song sung to the tune of *All things bright and beautiful* but entitled *All things weird and scary*. It described various outcomes of nanotechnology and framed them as unwanted and ineffective, making people "less than human" and granting immortality rather than wisdom.

This description of the group's discussions shows no striking distinguishing features; rather, there is a large degree of continuity with the other groups in the kinds of narratives created around nanotechnology. We turn to examine instead the ways in which these stories were created, resourced and reflected upon, arguing three key points about the specific language the group had access to.

Our first point is straightforward. It is simply that, as churchgoers, the group could readily access specific vocabularies in order to construct their responses to nanotechnologies. As an example we take a short stretch of collaborative talk in which the group are attempting to express their response to pervasive computing applications of nanotechnology (such as in surveillance or 'smart' environments; see Royal Society and Royal Academy of Engineering 2004):

> Ed: I dunno, it's coralling people. I think it's just really controls you.
> Mary: It's like removing the human soul, isn't it?
> Cath: It is.
> Mary: It's removing what it is that makes us individual and replacing it with-
> Ed: Convenience.
> Mary: -a technology that says "don't worry, I know what you want, I know what you need, I know what you fancy."[vii]

The story being created here is not unique to this group. It tells of nanotechnology's dehumanising effects as it strips away autonomy and individuality (see section 3.1): thus the technology comes to control, to remove choice and to 'nanny' (the implication of Mary's last turn). However, in line two Mary

uses a specifically religious shorthand to express this when she suggests that the technology's effects are "like removing the human soul" – a point which Cath affirms in line three. Mary goes on to expand on exactly what this means; Cath's affirmation indicates, however, that Mary's meaning is already clear to her.

Throughout the group's discussion similar language drawn from religious activity is used and concepts such as God, the soul, spirit, and eternal life brought in to construct arguments. There are, of course, some commonalities with the discourse of other groups in this. Phrases such as 'playing God' are used in religious and non-religious groups alike (though the churchgoers group were more likely to use this kind of language). This leads on to our second point: that when these references to religious or spiritual concepts occur, the churchgoers group were much more able to 'fill them in' or expand on them. Thus, for most of our groups, talking of 'playing God' or 'messing with nature' seem to act as symbolic expressions of the inexpressible. They truncate or end conversation: they have meaning, but that meaning cannot be further articulated. Take, for example, this exchange from the technology enthusiasts group:

> Jon: Isn't it weird how in the space of two hours we've gone from mobile phones to creating life with viruses?
> Mod: Yes- but it's still technology
> Jon: Well it is, but we're getting to a very dangerous stage now, where you're talking about being God really, aren't you? (*laughter*)

After the exchange ends in laughter – presumably triggered by the (perhaps rather clichéd) reference to 'being God' – conversation moves to a slightly different topic. Here the talk links to narratives of limits being transcended (section 3.1) and the sense of the hubris of science (section 3.2); these are, however, touched on rather than explored in detail. We have learned from Jon that there is an equivalence between 'being God' and danger, but nothing more; his presumed fears and concerns about this danger, and how it might be characterised, are not expanded on. There is a similar loss for words in the following extract, where talk is focussed around worrying threats to life/non-life boundaries:

> Kate: It's like they are trying to turn you into a computer.
> Mod: That's interesting. Is all this about trying to turn you into a computer?
> Lou: So you're more efficient.
> Mod: In what way do you think? They were thinking of you as if you were a computer? Say a little bit more about that.
> Kate: Um…I don't know, just to create an ideal world. (Natural health group)

Kate has brought up the notion that 'they' are using nanotechnology to erode human nature and "turn you into a computer". Again, this is a familiar story of threatened humanity. The moderator tries to probe this image further: is this process of dehumanisation what nanotechnology is about? And what does that involve? While Lou suggests this change is about efficiency, Kate's answer tails out with "I don't know" and a vague suggestion of the creation of an "ideal world". Her use of the computer image has pointed to something which she is unable to fully articulate: it is deeply symbolic, but its full meaning is difficult to express.

We might compare the failures of language these groups are struggling with – around key, but largely unexpressed, notions of what should be 'sacred' (cf Davies 2006) – with talk on a similar topic in the churchgoers group. The group are discussing nanotechnology's potential for human enhancement – again, something that was frequently understood as threatening what it is to be human:

Ed: If it gets to the stage where it's- it's the human enhancement. Are we playing God to a certain extent?
Mod: Yeah.
Cath: It's almost like replace-
Ed: Because if we can do everything ourselves why do we need [the] Almighty?
Cath: The science becomes God in a way.

Here we see the familiar trope of 'playing God' used by Ed to convey his concern about human enhancement. Immediately, however, and in contrast with Jon's use of the term above, what this means is 'filled in' and expanded by Ed and Cath: Ed explains that "if we can do everything ourselves why do we need the Almighty?", while Cath says that the science is acting to replace – or become – God. In both explanations the notion of human interference in sacred territory is further developed. 'Playing God' will lead to human self-sufficiency, pushing the 'Almighty' from spaces that are rightfully his (Ed), and in fact involving the replacement of God with science (Cath). Rather than working to end conversation, the use of the 'playing God' phrase has stimulated it.

It seems, then, that this group's religious affiliations provide them with a language that can help express the concerns that all our groups raise about nanotechnology's potential to impinge on sacred spaces. While other groups point to these concerns, but often struggle to characterise them, the churchgoers group have access to language that can equip them to articulate these notions of threatened humanity and scientific hubris. The content, themes and concerns are the same, but the explicit calls to the theological seem to enable fuller accounts, filling in the details of what is threatened, and how. Our final point is that the use of these specific linguistic resources can actually open up spaces for reflection on and around these notions; that the churchgoers group, because of their use of languages of spirituality and relationality, could deliberate particularly thoroughly on all that nanotechnology might mean for lived human lives.

As an example of this we take a stretch of discussion from the start of the workshop where the group are summing up their views and the concerns they have raised. The moderator is writing notes on a flip chart; as the extract starts, he asks for some of the preceding discussion to be repeated:

Mod: Can I capture a bit more about what makes us human, which you mention is the capacity to…
Delia: Capacity for relationships, you know the whole relational idea, how we relate to each other, what is valuable, how value is placed on human beings I suppose.
Cath: I would say interaction with the world around you as well, as people.
Mod: I just want to see what the threat- and the Christian sense then that we are all of equal value. Yeah? And in what way does nano threaten that, specifically?
Mary: Well, there will be kind of potential for selecting people to enhance them. The very term enhancement means-

Delia: The very meaning of enhancement, what is that value judgement?
Mary: -better than. You're enhanced, you are not enhanced.
Cath: Stronger and happier and whatever, is better than-
Delia: It's divisive.
Mary: Different kinds of discrimination will occur.
Tessa: Like an apartheid.

The section of talk starts with a statement – or rather, a repetition of a statement – of what it is to be human (in the context of what is being threatened by nanotechnology). Delia emphasises the notions of *relationality* and *value*, filling this out with a string of explanatory clauses ("how we relate to each other" and following). From this description of being human, which draws on a particular kind of language ("relationships", "relate", "value") and which Delia has earlier described as being specifically Christian (the moderator picks up on this in his second turn), the group create a collaborative and free-form discussion, riffing on the linguistic building blocks Delia has provided to develop new positions. Cath, for example, picks up on the idea of relationality to emphasise that this must include "the world around you" as well as human actors. After the moderator's second turn, Mary, Delia and Cath create together an argument about the very notion of "enhancement"'s threat to equal valuing of diversity. Tessa's statement, that this will lead to an "apartheid", builds on their argument and completes it.

Language around 'being human' is thus used to improvise further discussion and to develop further positions. Here the use of specific linguistic resources opens up conversation and allows reflection as to what nanotechnology's implications will be: the group move, as this reflection occurs, from notions of relationality and value to the 'apartheid'-like consequences of the disruption of these notions. Such discussions are not limited to arguments about threatened humanity or the traditionally 'spiritual'. Rather, it seems that the resources this group have are flexible enough to create a range of stories, including ones about governance, power, ethical and fair use of new technologies, and the pitfalls of a consumer society. Strikingly, then, whereas in the extracts above talk about 'playing God' or threatened humanity closes down discussion, in this case such terms are used as the basis for further conversation and creative and collaborative elaborations of them. Space for deliberation is thus opened up as, in this process, multiple perspectives are created and tested.

5. Conclusions

In the last two sections we have described key themes which emerged from focus group discussions on nanotechnology and argued that one group in particular, composed of churchgoers, had particularly developed linguistic resources with which to construct and negotiate these. As we have noted already, the stories created by this group have much in common with those from other groups. The difference lies in the resources brought to bear in constructing these and the traction they have for further development, deliberation, and discussion. In particular, we have suggested that the churchgoers make use of specific vocabularies (using terms such as 'soul' and 'the Almighty' and drawing on specific discourses of relationality), that these terms function as a shorthand which can be expanded upon if

necessary, and, finally, that the process of this expansion is freeform and creative, acting to open up discursive space for further deliberation. Before reflecting more generally, there are several points to make with regard to these arguments.

Firstly, it is important to note that we are not suggesting that our data indicates a contrast between naïve and inarticulate non-religious laypeople, on the one hand, and well-resourced and sophisticated churchgoers, on the other. *All* of the groups created sophisticated arguments and narratives about nanotechnology's threats and promises, and all resourced these in multiple ways using a range of sources. The churchgoing group had a particular shared language with which they could do this, which made it easier for them to articulate values shared throughout all of the groups: their cultural tool kit contained linguistic resources helpful for talking about nanotechnology. In this way they can be seen as a 'voice' for these shared values, articulating notions which others at times found it difficult to express.

Second, we are also not suggesting that this group were unique as Christian churchgoers. It seems likely that religious affiliations of any kind would provide similar resources with which to make sense of new technologies. (Simpson's work on new reproductive technologies in Sri Lanka (2004a; 2004b), for example, has shown how Buddhist folk literature was used to provide a language for the negotiation of these techniques.) This claim, however, has not been – and cannot be – tested within our data, focused as it is within a particular context. Further research must address the question of how more religiously plural contexts affect this process of resourcing the negotiation of emerging technologies.

We also do not want to create a distinction between the 'theology' of our churchgoers group and the responses or 'concerns' of other participants. As Deane-Drummond et al. (2003) argue, and as we suggested at the end of section 3, all responses to developments such as nanotechnology – from religious and non-religious voices alike – can be understood in theological terms. The narratives created in our groups depict nanotechnology as raising questions around what it means to be human, what a right relationship with our surrounding environment is, how society should be ordered, and what it means to live 'ethically' and well (to name a few). In this sense, all of our participants have been 'doing' theology. This also aligns with Szersynski's analysis of science and society (2005). All negotiations of science, he suggests, and indeed all of science itself, are intrinsically and inevitably theological – whether this is acknowledged or not.

As we conclude we want to reflect on two further points that arise from our discussion; firstly by returning to the analogy with GM. As we noted earlier, there are striking similarities between our findings, derived from lay discussions of nanotechnology, and those from a study conducted ten years earlier on lay talk about GM (Deane-Drummond et al. 2003; Grove-White et al. 1997). In fact, we might argue that nanotechnology – which encompasses GM in its promises of the 'next industrial revolution' (Roco 2001) – has acted to *intensify* these concerns (cf Macnaghten 2009). Our groups appear to bring forth stronger statements of the inviability of orders, the inevitability of their bulldozing, and the powerlessness of laypeople. Despite these intensifications – or perhaps as part of their cause – the nature and motivations of the institutions involved are understood as having remained more or less the same. The latent anxieties around contemporary science and technology's purposes, drivers and control

brought to the surface a decade ago by GM – and representing, as Brian Wynne has argued (1996), unease at the 'institutional body language' of those controlling new technologies – thus seem to remain present within lay cultures.

The way in which such anxieties were expressed was exacerbated, it has been suggested, by the ways in which scientific developments were framed and represented by the elites driving them (Deane-Drummond et al 2003; Wynne 2003). Such accounts not only hide the value commitments contained within science within a bracket of 'rationality', but typically present faith-based concerns as minority and naïve partisanship. That religious perspectives are not representative of wider public concerns is, in many cases, taken as read. Our argument has been rather different. In fact, we have suggested that our data implies the exact opposite of such assumptions: the concerns and talk of those with religious affiliations may actually be seen as *exemplary* of laypeople's negotiations of new technologies. Not only is there little difference in the character of the concerns and anxieties expressed, but religious affiliation appears to provide a language with which shared values can be articulated. If this is the case, it calls for a radically different way of framing contributions to debates around new technologies. Currently both expert and lay talk marginalises and positions as embarrassingly "wishy-washy" – a quote from our data – faith-based perspectives. At the very least, our data has suggested that those from lay religious groups should be considered as having valuable contributions to make. We might suggest that such arguments can be pushed further to highlight a fundamental disconnect between the implicit theologies of policy and scientific discourses and those of lay publics, whether secular or religious. Within the arena of nanotechnology policy, for example, discussions of 'social and ethical issues' frequently remain fixated upon questions of risk and safety (for example, Royal Commission on Environmental Pollution 2008). Such questions are, of course, important. But the discourses which bound them – of science, rationality, and control – contain no space for the deeply theological questions which have emerged from our focus groups and which are expressed in a particular form within the talk of the churchgoers group. One way forward, we might suggest, is in a willingness to open up debate to such questions and to let the theological into science policy. Such an approach could, through making use of the resources held within the religious and the theological, present an opportunity to move beyond sterile risk debates and to genuinely deepen policy discourse, enabling it to better keep step with the tenor of public concern.

References

Beck U. 1992. *Risk Society: Towards a New Modernity*. London: Sage.

Billig M. 1987. *Arguing and Thinking: A Rhetorical Approach to Social Psychology*. Cambridge: Cambridge University Press.

Bruce D. 2006. Ethical and social issues in nanobiotechnologies. *EMBO Reports* 7 (8): 754-758.

-----. 2007. *Engaging Citizens on Nanobiotechnology Using the DEMOCS Game*. Interim report on DEMOCS Games on NANOBIOTECHNOLOGY played in the UK and The Netherlands, NanoBio-RAISE EC FP6 Co-ordination Action, Work Package 3.

Caiazza JC. 2005. Athens, Jerusalem, and the Arrival of Techno-Secularism. *Zygon* 40 (1): 9-21.

Davies G. 2006. The sacred and the profane: biotechnology, rationality, and public debate. *Environment and Planning A* 38 (3): 423-444.

Deane-Drummond C, Grove-White R, and Szerszynski B. 2003. Genetically Modified Theology: The Religious Dimensions of Public Concerns about Agricultural Biotechnology. In *Re-ordering Nature: Theology, Society and the New Genetics*, eds C Deane-Drummond, B Szerszynski and R Grove-White, 17-38. London: Continuum.

Frazer JG. [1922] 1995. *The Golden Bough: A Study in Magic and Religion*. Herts: Wordsworth.

Gaskell G, Eyck TT, Jackson J, and Veltri G. 2004. From our readers: Public attitudes to nanotech in Europe and the United States. *Nature Materials* 3 (8): 496.

Grove-White R, Macnaghten P, Mayer S, and Wynne B. 1997. Uncertain World: Genetically Modified Organisms, Food and Public Attitudes in Britain. Lancaster: Lancaster University.

Grove-White R, Macnaghten P, and Wynne B. 2000. Wising Up: The Public and New Technologies. Lancaster: Centre for the Study of Environmental Change, Lancaster University.

Heelas P, Woodhead L, Seel B, Szerszynski B, and Tusting K. 2004. *The Spiritual Revolution: Why Religion is Giving Way to Spirituality*. Oxford: Blackwell.

HM Government. 2005: *The Government's Outline Programme for Public Engagement on Nanotechnologies*. London: Department of Trade and Industry.

Jasanoff, S. 2005: *Designs on Nature: Science and Democracy in Europe and the United States*. Princeton: Princeton University Press.

———. 2006: Technology as a site and object of politics. In R E Goodin and C Tilly (eds.) *The Oxford Handbook of Contextual Political Analysis*. Oxford: Oxford University Press.

Kearnes M, and Wynne B. 2007. On Nanotechnology and Ambivalence: The Politics of Enthusiasm. *NanoEthics* 1 (2): 131-142.

Kearnes, M. B., Grove-White, R., Macnaghten, P. M., Wilsdon, J., and Wynne, B.. 2006a: From bio to nano: learning lessons from the agriculture biotechnology controversy in the UK. *Science as Culture* 15(4): 291–307.

Kearnes M. B, Macnaghten P, and Wilsdon J. 2006b. Governing at the Nanoscale: People, policies and emerging technologies. London: Demos.

Kjolberg K, and Wickson F. 2007. Social and Ethical Interactions with Nano: Mapping the Early Literature. *NanoEthics* 1 (2): 89-104.

Levitt M. 2003. 'Just because we can do something doesn't mean we should': Young People's Responses to Biotechnology. In *Re-ordering Nature: Theology, Society and the New Genetics*, eds C Deane-Drummond, B Szerszynski and R Grove-White, 186-201. London: Continuum.

Macnaghten P. 2004. Animals in their Nature: A Case Study on Public Attitudes to Animals, Genetic Modification and 'Nature'. *Sociology* 38 (3): 533-551.

Macnaghten P. 2009 in press. Researching technoscientific concerns in-the-making: a narrative structures, analysis of public responses to and emerging nanotechnologies. *Environment & Planning A*

Macnaghten, P. M., Kearnes, M. B., and Wynne, B. 2005: Nanotechnology, governance and public deliberation: what role for the social sciences? *Science Communication* 27(2): 268-87.

Mol, A. 2003: *The Body Multiple: Ontology in Medical Practice*. Durham, N. C.: Duke University Press.

NNI: Nanoscale Science, Engineering and Technology Subcommittee. 2004. National Nanotechnology Initiative Strategic Plan. Arlington: National Nanotechnology Coordination Office.

Nye, D. E. (1994), *American Technological Sublime*, Cambridge, MA.: MIT Press.

Opinion Leader. 2008. Report on the Citizens Panel examining nanotechnologies.

Peter D.Hart Research Associates. 2007. Awareness Of And Attitudes Toward Nanotechnology And Federal Regulatory Agencies. Project On Emerging Nanotechnologies, The Woodrow Wilson International Center For Scholars.

Rip A. 2006. Folk Theories of Nanotechnologists. *Science as Culture* 15 (4): 349-365.

Roco MC. 2001. From Vision to the Implementation of the U.S. National Nanotechnology Initiative. *Journal of Nanoparticle Research* 3 (1): 5-11.

Roco M., and Bainbridge, W. S., eds. 2001: *Societal Implications of Nanoscience and Nanotechnology*. Boston: Kluwer Academic Publishers.

Royal Commission on Environmental Pollution. 2008. Novel Materials in the Environment: The case of nanotechnology. London: The Stationery Office.

Royal Society and Royal Academy of Engineering. 2004. Nanoscience and Nanotechnologies: Opportunities and Uncertainties. London: Royal Society.

Schummer J. 2006. Cultural diversity in nanotechnology ethics. *Interdisciplinary Science Reviews* 31 (3): 217-230.

Simpson B. 2004. Acting ethically, responding culturally: framing the new reproductive and genetic technologies in Sri Lanka. *The Asia Pacific Journal of Anthropology* 5 (3): 227-243.

-----. 2004. Impossible Gifts: Bodies, Buddhism And Bioethics In Contemporary Sri Lanka. *The Journal of the Royal Anthropological Institute* 10: 839-859.

Swidler A. 1986. Culture in action: Symbols and Strategies. *American Sociological Review* 51: 273-286.

Szerszynski B. 2003. At Reason's End: Inoperative Liturgy of Risk Society. In *Re-ordering Nature: Theology, Society and the New Genetics*, eds C Deane-Drummond, B Szerszynski and R Grove-White, 202-220. London: Continuum.

-----. 2005. Rethinking the Secular: Science, Technology, and Religion Today. *Zygon* 40 (4): 813-821.

-----. 2006. Techno-demonology: Naming, Understanding and Redeeming the A/Human Agencies with Which We Share Our World. *Ecotheology* 11 (1): 57-75.

Tamatea L. 2008. If robots R–US, who am I: Online 'Christian' responses to artificial intelligence. *Culture and Religion* 9 (2): 141-160.

Te Kulve H. 2006. Evolving Repertoires: Nanotechnology in Daily Newspapers in the Netherlands. *Science as Culture* 15 (4): 367-382.

Weasel L, and Jensen E. 2005. Language and values in the human cloning debate: a web-based survey of scientists and Christian fundamentalist pastors. *New Genetics & Society* 24: 1-14.

Wilsdon J, Wynne B, and Stilgoe J. 2005. *The Public Value of Science: Or how to ensure that science really matters*. London: Demos.

Wynne B. 1996. May the Sheep Safely Graze? A Reflexive View of the Expert-Lay Knowledge Divide. In *Risk, Environment and Modernity: Towards a New Ecology*, eds S Lash, B Szerszynski, and B Wynne, 44-83. London: Sage.

Wynne B. 2003. Interpreting Public Concerns about GMOs – Questions of Meaning. In *Re-ordering Nature: Theology, Society and the New Genetics*, eds C Deane-Drummond, B Szerszynski and R Grove-White, 221-248. London: Continuum.

[i] See the Department for Innovation Universities and Skills' (2008) consultation on 'Science and Society' for the most recent iteration of this policy discourse.

[ii] See http://www.nanotechproject.org/inventories/consumer/.

[iii] We sought to develop selection criteria where groups of people were likely to develop deep conversations based on shared experiences and where arguments about nanotechnology could be jointly developed. While we did not seek representativeness (being interested more in the range and variability of meanings in the population at large) we nevertheless aimed to tap into significant fractions of society. We thus selected groups around commonalities likely to be of relevance to the discussion of nanotechnology. Based on previous research, relations to the body, environmental issues, technology, governance, notions of limits and moral boundaries, and a sense of personal agency were all seen as likely to be key in structuring responses to nanotechnology (Kearnes et al 2006b), and groups were selected around relationships to these factors. The final groups were as follows:

1. Church attenders group, recruited from a single church.
2. Student environmental group, recruited from the organisation People and Planet.
3. Natural health group (users of organic produce and natural health techniques).
4. Confident believers group (positive towards technology and its governance).
5. Local involvers group (active or potentially active within local community).
6. Authority figures group (sense of personal agency and control).

[iv] Kearnes et al. (2006b) review this early public attitude research and the predictable pattern of results.

[v] Similarly, previous work has examined the repertoires of resources present within expert cultures (Rip 2006) or those presented by media sources (te Kulve 2006).

[vi] While the church attenders group was selected specifically for their religious affiliation, the groups were not selected in ways that were mutually exclusive and therefore other groups may have contained participants with religious belief. However, no other groups were brought together around a commonality of expressed faith, and identities in these groups tended to be constructed around secular features (such as a love of technology or activity within the local community).

[vii] Where we show extracts of conversations (rather than quotes from individuals) we provide anonymised names to indicate speakers. 'Mod' indicates the focus group moderator.