

# **Understanding Public Responses to Emerging Technologies: A Narrative Approach**

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## **Abstract**

Previous studies aimed at understanding public responses to emerging technologies have given limited attention to the social and cultural processes through which public concerns emerge. When probed, these have tended to be explained either in cognitive social psychological terms, typically in the form of cognitive shortcuts or heuristics or the influence of affective variables, or in social interactionist terms, as a product of the micro dynamics of the social interaction. We argue for an alternative approach that examines how public attitudes are formed in relation to the interplay of wider cultural narratives about science and technology. Using data from recent qualitative research with publics on nanotechnology and other emerging technologies we develop a typology of five cultural narratives that underpin and structure public talk. The narratives we identify within focus group talk are familiar stories that are deeply embedded in contemporary culture, and which provide cultural resources for navigating the issues posed by emerging technology. Substantively, they inform a 'tragic' mood on the prospects of emerging technology, reflecting the loss of belief in science, when coupled to neoliberal logics, as guaranteeing social progress. The implications for policymaking are discussed.

## **Introduction**

A core argument of science and technology studies (STS) is that emerging technologies have potentially far-reaching social consequences and that a certain degree of work (political, cultural, institutional) may be required to ensure their alignment with broader social values. Such thinking has informed various forms of technology appraisal, from constructive technology assessment to real-time technology assessment or socio-technical integration, activities which are currently being consolidated under the framework of responsible research and innovation (RRI), a suite of initiatives that attempts to introduce and integrate ethical reflection, public dialogue and reflexivity into multi-level forms of science

governance and research policy design (for an overview, see Owen, Macnaghten, and Stilgoe, 2012; Owen, Macnaghten, Stilgoe, Gorman, Fisher, and Guston, 2013).

A significant proportion of this work (much of which has focused on emerging technologies such as nanotechnology, synthetic biology and geoengineering) has aimed to understand public attitude formation. It is now widely recognised that understanding the processes through which publics make sense of emerging technologies and develop responses to them is critical for the design and coordination of reflexive mechanisms for public engagement and participation. However, as we will argue in this paper, the principle approaches to thinking about public perceptions of new technology – and specifically cognitive social psychological theory on attitude formation – represent a deeply inadequate model of the way in which laypeople make sense of novel technologies, and of the substantive issues they raise. As a consequence, this work offers rather unitary policy prescriptions. Our argument is that it is important for scholarship in the social studies of emerging technologies to conceptualise more robustly the process of ‘opinion formation’ and thus to understand how publics respond to new technologies such as nanotechnology. As we have argued elsewhere (see Davies, Kearnes, and Macnaghten, 2009; Davies and Macnaghten, 2010; Macnaghten, 2010), the fact that people are, by definition, unfamiliar with emerging technologies, and with the social issues they raise, presents significant challenges to traditional methods for assessing public attitudes and preferences via quantitative public opinion surveys. This article therefore reflects on these challenges, on how public negotiations of emerging technoscience can be conceptualised, and on the implications of this for policy frameworks that seek to respond to ‘public views’.

In what follows we make a number of moves: first, we discuss the limitations of existing approaches to public responses to new technology; second, we outline our conceptualisation of narrative as a (partial) solution to these problems; third, we demonstrate these concepts in practice through a discussion of the emergence of particular narratives in public discussions of emerging technology. Finally, we reflect on some of the affordances and implications of a narrative approach for the governance of emerging technology, in particular discussing the politics of technological development which a narrative approach can help articulate.

### **Existing Approaches to Public Opinion Formation**

Much work on public perceptions of technology has adopted a broadly aggregative model of

public opinion formation, wedded to forms of 'methodological individualism'. The assumption has been that attitudes are formed either by cognitive or affective factors, and that these rely on heuristics or cognitive shortcuts such as media frames, ideological predispositions or religious beliefs (for an overview, see Lee, Scheufele, and Lewenstein, 2005; Scheufele and Lewenstein, 2005). Research on affective factors has examined whether and how people use emotional judgments in competition with cognitive factors in shaping their overall perceptions of the technology and their acceptance of it (Nisbet, Brossard, and Kroepsch, 2003; Priest, 1995, 2001), while a related line of research on public perceptions has focused explicitly on the emotion of trust (e.g. in scientists, regulations, or institutions) in shaping public attitudes (Macoubrie, 2005, 2006; Priest, 1995, 2001). These models of public opinion thus seek to identify the influence of internalised heuristics that shape individual attitudes, taking quantitative aggregation as a proxy for 'public attitudes' to novel technologies. Approaches informed by this perspective therefore assume that there exists a domain of human thinking, attitudes, values and opinions that is both internally consistent and that reflects underlying cognitive processes. One implication of this approach is the tendency to present public attitudes in ways that obscure wider social, economic and political processes underpinning processes of attitude formation.

In contrast, traditions within conversation analysis and studies of public perceptions of risk have drawn on symbolic interactionism, ethnomethodology and pragmatist linguistic theory to explore both the interactive qualities of public talk and modes of collective sense-making. Rather than assume the *a priori* existence of public attitudes toward this or that new development, interactionist studies have focused on the performative qualities of public 'talk' in action, and in particular the situationally-specific modes of practical reasoning deployed in qualitative group discussions (Hoffman et al., 2003; Horlick-Jones, 2007; Horlick-Jones and Prades, 2009; Horlick-Jones, Wall and Kitzinger, 2007; Sarangi et al., 2003; Wall 2011). Rather than simply an index of external and pre-existing variables, in this model public attitudes are formed in profoundly situated and interactive contexts. Publics deploy diverse reasoning strategies – by analogy or inference, for example – to render new developments culturally meaningful. Though focusing on the situated and interactive quality of public reasoning, public attitudes in this model are also seen as shaped by the *signature* of novel technologies, 'the specific ways in which [their] material features are articulated in practical reasoning and discourse within real-world settings' (Horlick-Jones et al., 2007, p. 85).

Such approaches therefore attempt to escape methodological individualism and to

ground research on public perceptions of science and technology in ‘a careful analysis of the fine detail of actors’ practical reasoning, embedded as it is within processes of social interaction’ (Horlick-Jones and Prades, 2009, p. 411) together with an analysis of the ‘constraints and opportunities (and risks) presented by the technology as apprehended in specific social contexts’ (Horlick-Jones et al., 2007, p. 85). However, it can be argued that such interactionist approaches focus too strongly on individuals-in-interaction as reasoning agents, ignoring the role of other resources in the formation of ‘public opinions’. If public responses to novel technological systems are formed in interactive contexts, one critical question concerns what shapes the emergence of public issues and the trajectories of public talk beyond the micro dynamics of face-to-face interaction? What of the heritage – discursive, cultural and theological – of public talk on new technology and the resources deployed in making novel innovation sensible?

### **Narrative Approaches**

Our response to these issues has been to craft a notion of *narrative* that can enable us to understand how public responses are articulated in a space between moment-by-moment interaction and internalised cognitive social psychological heuristics. More specifically, our aim is to understand how the deployment of argumentative resources – whether in conversation, focus group discussion, or survey questionnaires – are consolidated and sedimented through social interaction and discourse. Such resources function not only as interpretive aids or as a cultural tool-kit, but as an articulation of the boundaries of argumentation itself. Again, if we are to think of public responses not simply as the aggregate of individual attitudes and preferences but as the struggle toward a vocabulary with which to attribute meaning, rhetorical and narrative resources provide an outline of the cultural and moral ‘work’ that is undertaken in this collective accomplishment (Hilgartner and Bosk, 1988). In this section we discuss some of the conceptual inspiration underpinning our narrative-based approach, before outlining some specific research in which we have attempted to develop this approach.

While the constraints of methodological individualism have been well documented in recent years, the commitment to a figure of an autonomous human agent who possesses unique preferences and opinions is a component of what Proctor (1998) describes as the problem of ‘separability’. Underpinning aggregationist models of public attitude research is the assumption that the ‘human dimensions’ of environmental and technological change can

be 'analysed as if it were essentially independent' (p. 228). John Milbank (2006) locates this notion of separability in an Enlightenment tradition that seeks to create a 'sharp distinction between the natural and the human sciences, with the accompanying claim that the latter pursue goals ... of understanding, while the former pursue goals of explanation' (p. 263). One implication of this separation is that while STS-inspired research has developed highly sophisticated means for understanding the social dynamics of science and innovation, for the most part such research has been characterised by relatively naturalistic methods for understanding public talk.

In comparison, we aim towards a more symmetrical understanding of the social life of science and technology through a concept of narrative that speaks to the dialogic work that underpins *both* the development of scientific and technological artefacts and the cultural practices that render them publically meaningful. In this sense a narrative turn aims to explore the ways in which contemporary technoscience – 'preoccupied with narratives of the transformation of nature' (Milbank, 2006, p. 270) – is situated in ways that renders it culturally, morally and affectively sensible. In contrast to interactionist accounts of public reasoning practices, which tend to focus on the material affordances of new technologies in shaping public responses, we suggest that narrative helps to ground analysis in the dialogic process of sensemaking, as characterised by a relational negotiation of narratives of transformation, enhancement and accumulation that constitute the imaginative terrain of contemporary techno-politics.

Critical to this move is a concept of narrative consolidation and the emergent quality of public articulation. On the one hand we seek to avoid a structuralist approach that views narrative as a window onto deep structures by which meaning is produced and reproduced within cultures; while on the other we reject a theorisation that depicts public reasoning as contingent only on the interactive dynamics of public discussion. Drawing on pragmatist traditions we offer a conception of social interaction and political discourse as resourced by recurrent cultural narratives and imaginaries – what Taylor (2004) usefully terms 'modern social imaginaries' – while at the same time maintaining a notion of the performative quality of enunciation and enactment. Such resources are actively mobilised in order to give meaning to individuals' lifeworlds and actions, but are also shaped and transformed in the context of their enactment. Though consolidated in institutional practice and in shared forms of public reason, these cultural resources are not determinative. Instead, they are characterised by a 'combined sensitivity to both the ongoing involvement of individuals with processes of meaning making and agency, as well as the macro-cultural frameworks that

structure such processes' (Silber, 2003, p. 429). We thus view narratives as operating in two important ways. First, they depict the world at a level of generality that renders the moral wisdom they encapsulate – such as notions of transgression or dilemmas of ultimate purposes and intent – applicable across a range of contexts. Second, narratives operate as stories, with distinct storylines and characters and through the attribution of roles and responsibilities (Hajer 2005) that, in the case of technological development, speak to the likely trajectory of the socio-technical dynamics at play.<sup>1</sup>

### **Mobilising Narrative in Public Engagement Research**

How can a narrative approach to public views be mobilised in practice, in empirical research and analysis? It inevitably requires in-depth and relatively enduring research with publics on emerging technologies aimed at exploring the factors shaping the formation of public opinions and attitudes across different technological domains. It also requires reflexive attention to the forms of talk that are generated in particular methodological discussion formats: how particular choices (e.g. in focus group design) facilitate particular kinds of talk and positions and opinion formation. Finally, it requires asking the following two broad sets of research questions.

- RQ1 What substantively are people concerned about when discussing emerging technologies? How are these concerns produced in and through interactive group discussion? What level of generality can be attributed to these matters of concern? To what extent are they shared across different kinds of publics and cultures? To what extent are they shared or not across different kinds of technologies?
  
- RQ2 What narratives do people draw upon in responding to emerging technology? How do these emerge in relation to narratives currently populating public debate, including from media discourse, from civil society discourse and as well as from those reflecting dominant institutional scientific, corporate and policy discourse? How and at what level and with what epistemological and ontological significance can these narratives be codified? And can these be considered in some manner or form 'arche' or master narratives?

In this and the following section we want to demonstrate how this approach, as exemplified by these research questions, has been designed into our work on public responses to emerging technologies, and the kinds of findings it can result in. While we are drawing on research ranging from an early project aimed at exploring public views and attitudes to agricultural biotechnology in Britain (Grove-White, Macnaghten, and Wynne, 1997) to recent research on public discourse on solar radiation management (Macnaghten and Szerszynski, 2013), we will focus on the example of a cross-European project on lay ethical engagement (Davies, Macnaghten, and Kearnes, 2009). The DEEPEN (Deepening Ethical Engagement and Participation with Emerging Nanotechnologies) research on lay ethical understandings of emerging nanotechnologies involved a three-part methodology: a initial focus group where participants discussed their views on technology and where different frames of nanotechnology were introduced; a reconvened focus group a few days later where people discussed what they considered to be the key issues at stake and where they worked on the presentation of these issues in the form of a sketch; and later that day a theatre session in which one focus group presented their sketch to another. The methodology was informed by Augusto Boal's forum theatre in encouraging improvisation so as to give people the opportunity to explore different possibilities and scenarios. This research and similar studies were based on six key design principles.<sup>2</sup>

First, given that by definition people are unfamiliar with emerging technologies and with the social issues they pose, the methodology is designed to elicit a contextual understanding of how people are likely to respond and the factors deemed most probable to shape future public responses. The focus on understanding *context* is a core element of the methodological design. In the DEEPEN project, this meant that experiences of current technology were a key feature of the opening discussion.<sup>3</sup>

The second design feature concerns *framing*. Given that technologies are never neutral but always framed in particular ways and for particular purposes, care is exercised to ensure that the emerging technology under investigation is introduced through an inclusive range of rhetorical resources and frames without closing down or narrowing the issue, or presuming these align with dominant institutional frames and norms (Felt et al., 2014; Stirling, 2008). Thus participants are presented with different frames or styles of thought (Fleck, 1979; Hacking, 1992; Rose, 2007), not simply of what the technology is, but what it explains and what it represents. These frames are encapsulated through the use of stimulus materials, typically making use of pre-designed large A1 boards, consisting of pictures and text (all attributed) and presented to the group by the moderator to stimulate conversation.

The third design consideration concerns the style and remit of the *moderator*. This role is considered integral to subsequent analysis and interpretation, and involves keeping the group on topic (using a well-formulated topic guide); listening empathetically and accurately to each participant's stories to ensure a diversity of voice independent of background or experience; probing difference and convergence between group members; articulating shared issue definitions when present; and moving from one topic to the next only when the full range of arguments appears exhausted (on the role of the moderator in interaction, see Barbour, 2008; Puchta and Potter, 2004; Macnaghten and Myers, 2004). To help ensure that the discussions are not framed by expert discourses and norms, none of the projects have included technical experts in the focus group discussions, as previous research has indicated that the presence of experts can induce deference to prior framings amongst lay participants (Wynne, 2006).

The fourth design feature concerns *sampling and group design*. The research methodology uses sampling strategies that are both broad and theoretically-derived: participants are professionally recruited to cover a diverse variety of backgrounds, localities and demographics (e.g. age, gender, socio-economic class) but with topic specific or theoretically informed variants: in the DEEPEN research this included participants who were early adapters of technology or individuals actively involved in their local community (Davies, Macnaghten and Kearnes, 2009; for an explanation of the idea of the theoretical sample, see Glaser and Strauss, 1967; see also Miller, Kitzinger, Williams, and Beharrel, 1998; Gobo, 2005). The decision to involve uninformed participants, who have no particular *a priori* stake or position in the debate, and who do not know each other prior to the group, is a technique explicitly designed to produce an open-ended sociality, where people can develop opinions and attitudes through structured interactive conversation in a safe and empowering space. In this way, the 'upstream' methodology can be considered as helping foster the creation of 'technoscientific citizens' who have been authorised to develop opinions on the social and ethical dimensions of emerging technology.

Fifth, there is the matter of *analysis and interpretation*. Macnaghten and Myers (2004) distinguish between two broad styles of analysis in focus group research: styles that converge on how people talk in focus group settings (often inspired by conversation analytical traditions; see also Myers, 2004) and those that focus on the content of what people say and where the role of the analyst is to interpret its meaning (often inspired by narrative or discourse theoretical traditions). Our approach is firmly in the latter camp, in which the role of the analyst is first and most importantly to become acquainted with the



raw data, to organise key rhetorical arguments into themes or discourses through the use of codes, to articulate the interplay between thematic concerns and wider social discourses, to identify how thematic concerns are resourced by underlying cultural narratives and to interpret this meaning within a framework of theoretical and policy concerns. This process therefore enables an analysis of the narratives which underpin the deliberation in the focus groups, and which can be understood as enabling the articulation (and negotiation) of particular positions or views on (nano)technology.<sup>4</sup>

Sixth, there is the issue of *ontology*. In relation to the question concerning the ontological status and significance of narratives – whether the narratives as deployed in public talk are deep or shallow, small or big, enduring or short-lived – our response is part pragmatic and part theoretical. On the one hand, our methodology seeks to derive answers to these questions as best we can from in-depth empirical research with publics, deriving from data common matters of concern if and when they exist. On the other hand, our method remains open to the possibility that relatively enduring ‘*arche*’ narratives may exist, that these may be especially pertinent to ‘upstream’ deliberations on emerging technologies, and that these they may provide publics, consciously or not, with the cultural resources to develop an imagination of the social issues associated with emerging technology (on the notion of the ‘*arche*’ narrative as a key structuring device in the reproduction of culture, see Heller, 2005).

In relation to the six design criteria listed above, the researcher(s) (as designer, facilitator and analyst of the focus groups) has a particular role and agency: to identify a theoretically-derived sampling strategy; to determine the relevant context to ground the focus group deliberation; to ensure the stimulus materials are designed to ensure an inclusive range of framing devices; to moderate the discussions to help articulate shared issue definitions, when present; and to analyse the transcripts with a particular orientation to questions of ontology and narrative.

### **Narrative findings from public engagement research**

In a meta-analysis of seventeen public dialogues on emerging science and technology sponsored by the UK Government Sciencewise initiative, we identified five broad thematic concerns that structured public responses (Macnaghten and Chilvers, 2014): these were concerns with the *purposes* of emerging technology; with the *trustworthiness* of those involved; with whether people feel a sense of *inclusion* and agency; with the *speed* and

*direction* of innovation; and with *equity* (whether it would produce fair distribution of social benefit). This typology, which we find to be broadly reflective of public concerns across each of our research projects, can be seen as a general approximation of the spheres of concern that surface in fairly predictable ways when people discuss the social and ethical aspects of emerging technology and which play a key role in structuring the formation of public attitudes (e.g. as to whether they find the technology acceptable or not and the conditions that are attached to that evaluation). Such meta-concerns are not separate from each other. They interact and form mutually reinforcing structures.<sup>5</sup> For example, in the case of agricultural biotechnologies, concerns with the speed of innovation are commonly driven by concerns about questionable purposes (e.g. corporate control of global food systems), which breed worries about inclusion and equity, which are themselves seen as needed as a means to defend against the untrustworthy.

Such findings differ markedly from dominant approaches to risk communication and risk perception research, which have tended to presume that public acceptability to emerging technology depends on how people weigh up risks and benefits, or assume that people are either 'pro' or 'anti' a particular technology (see Cobb and Macoubrie, 2004; Macoubrie, 2005, 2006; Peter D Hart Research Associates, 2008). Instead, one finding shared across each of our research projects is that all emerging technology is perceived to involve risk and uncertainty, and indeed that perceived 'benefits' may turn out not to be beneficial at all. Public responses to novel technologies are thus rarely expressed in simple distributional terms, of maximising the 'benefits' of technology while minimising its harms. Rather the narratives deployed by publics to make sense of novel developments speak to the moral meanings of technology, its purposes, significance and possible transgressive potential. In this sense, the findings from our research thus differ markedly from the key modernist narrative of science that imagines technology to drive inexorably forward and to bring, with appropriate governance and steering, inevitable social benefits (Felt et al., 2007).

This is not to imply that people do not tell positive stories about science. They do. Our focus group discussions are replete with stories about the power of scientific breakthrough, the virtues of scientific curiosity and the potential for science to ameliorate human ills. Nevertheless, in the context of the various technologies under question (i.e. biotechnologies, nanotechnologies and geoengineering technologies), people rarely express confidence that scientific innovation under real-world conditions and under current structures of regulation and oversight will mitigate against unforeseen harms and ills. Which begs the question: if people are not drawing on this standard narrative, what counter

narratives are being drawn upon to structure public responses (Bamberg and Andrews 2004)? In exploring this question the DEEPEN research identified five underpinning cultural narratives, all familiar in Western culture, which were continually enacted and re-performed in the focus group discussions. We now describe each of these in turn in order to demonstrate the ways in which narratives may be identified and analysed in public discussions.

*(1) Be careful what you wish for*

The 'be careful what you wish for' narrative is a very old story. As Jean-Pierre Dupuy recounts in his narratology of the five DEEPEN narratives, the idea that getting exactly what you wish for may lead to unforeseen disaster and catastrophe 'is one of the most ancient wisdoms of the Western world and, probably, of humankind in general, as soon as it begins to reflect on the relationship between human desire and the human good' (Dupuy, 2010, p. 155). Dupuy discusses the multiple ways in which the dangers of 'boundless desire' have been narrated in European thought: from philosophy, folklore, literature (adult and children), song, poetry and film. He analyses in particular the 'The Three Wishes' folk tale as told by the Grimm brothers, variants of which, he suggests can be found in almost every European culture. The narrative has three elements. First, there is the granting of three wishes, usually through some form of magic, that represents the boundless of desire. Next, there is the foolishness of the first wish, representing the chasm between 'everything' that could be wished for and a trivial and mediocre whim or caprice (in this case, 'I wish I had a string of sausages'). Then, there is the skandalon, the realisation of the waste of the first wish and the formulation of a second foolish wish conceived under the influence of anger, frustration, insult and even violence (in this case, 'I wish they [the sausages] would stick up your nose') and which only the third wish can eliminate (in this case 'I wish the sausages would leave my wife's nose'). The net result is the meager satisfaction of the first foolish wish and a lost occasion of momentous proportions. More generally it speaks to the absurd logic of boundless desire and of the renewed recognition of the virtues of everyday practices and relationships, such as family, marriage, community and being proximal to nature.

Each of the improvised plays presented by our lay publics in the DEEPEN research could be regarded as a modern-day morality tale, where nanotechnology came to represent a particular kind of seduction (e.g. of eternal youth, control over nature, cures for all illness, perfect bodies and other forms of 'boundless desire') and where the quest to realise these (false) pleasures and desires were seen to lead to unforeseen consequences and at times disaster. Thus, variously, nanotechnology innovation, driven by capital and neoliberal logics,

was seen as likely to exacerbate, inter alia, further individualism and conspicuous consumption, sloth and insularity, local and global inequalities, and ultimately free-will and what it means to be human. The moral of the plays was that it is precisely through how one deals with adversity and human relationships, typically through traditional virtuous activity (such as humility, kindness, patience, diligence, charity, acceptance of finitude and of life as a gift and so on) that constitutes what in Aristotelian terms could be considered 'the good life'.<sup>6</sup>

### (2) *Pandora's Box*

The story of Pandora's box is a familiar one: a temptingly closed box that, when opened, releases the gamut of human evils. The story has its origins in ancient Greek mythology: Pandora, the first woman, was given a huge jar which she was instructed not to open. Out of sheer curiosity, Pandora opened the lid and all the evils, miseries, diseases, illnesses that mankind had been spared from previously flew out and infected the world. The Pandora myth is thus a form of theodicy that purports to explain, if not justify, the existence of evil in the world. In our focus group discussions the Pandora box story provided a linguistic set of resources to enable people to justify why emerging nanotechnology in their opinion was likely to prove to be dangerous and ill-considered. In response to especially radical and utopian claims for the technology, even though such innovations were not born of evil intent, people commonly used variants of the narrative to justify why that such radical scientific intervention on nature was seen as likely to release all sorts of unforeseen dangers and perils. According to one participant, 'It looks great but you take the lid off and then out it comes, there's no getting it back in again', while another explained, 'I think it's accelerating the evolution of disasters ... It'll get "out of the cage", I'm sure, and evolve'. Such perspectives point to the 'thoughtlessness' associated with our incapacity to anticipate the consequences of our actions due, in part, to our capacity to make things that go beyond our imagination, or what Günther Anders, in response to the nuclear threat, referred to as our collective 'blindness to the apocalypse' (Anders, 1982).<sup>7</sup>

### (3) *Messing with nature*

A close variant was the 'messing with nature' narrative. The idea that emerging technology has the potential to 'mess with nature' relies on the ancient idea of nature as having sacred qualities that establishes norms or order to the human world. As such, nature sets moral and ethical boundaries that human beings should not transgress. Again, this is an ancient Greek story, linked to the Greeks' conception of the sacred: the Gods, proving to be jealous of men, sent after them the goddess of vengeance, *Nemesis*, who unleashed revenge upon

those who succumbed to the vice of hubris: arrogance before the Gods. The ‘messing with nature’ narrative was used in focus group talk to help explain the potential pitfalls of a technoscientific endeavor that was seen as disruptive of natural orders and boundaries, and that did not respect preordained limits or basic human values. The problem here does not lie with intervention per se; the key element in this narrative is the association of radical intervention with ‘messing’, or alternatively ‘interfering’, ‘fiddling’, ‘tinkering’ or ‘meddling’: i.e. with ill-considered action. With nanotechnology, the ‘messing with nature’ narrative was commonly deployed in response to nanotechnology’s promissory ambitions to extend control over the human and natural world, such as in programmes that rely on what Bensaude-Vincent calls a thoroughly ‘artificialist view of nature’ (Bensaude-Vincent, 2004; see also Macnaghten, 2010).<sup>8</sup>

#### *(4) Kept in the dark*

The ‘kept in the dark’ narrative is a different kind of story. It is deployed in contexts where people feel powerlessness in the face of an emerging technology and, in particular, where they feel they have been left unaware of the technology’s existence and potential. It speaks to the concept of alienation, in the modern sense of being disenfranchised from the R&D innovation process. There exist two variants: either that emerging technology is being controlled by elite actors (governments, corporations, corporations, the media) and where lay people are intentionally being ‘kept in the dark’ or, alternatively, that emerging technology has its own internal dynamics and logics that influence society in ways that are largely beyond cultural or political influence. This broad narrative was used to underpin people’s sensed lack of agency. Participants felt dependent and thus compelled to trust ‘expert systems’ (governments, regulators, scientists, corporate R&D, media reporting) responsible for the development and governance of emerging technologies but deeply powerless over their conduct. This feeling was particularly evident in discussions on nanotechnology, where people’s unfamiliarity with the technology was associated with a strong sense of implied secrecy.<sup>9</sup>

#### *(5) The rich get richer*

Our final narrative is the ‘rich get richer’. Again largely a modern story, in so far as it is premised on the ideal of social equality as a foundational element in modernity, it speaks to the potential of emerging technology to engender further injustice and inequality, both globally and locally. Ultimately, the narrative goes, promises of environmental or inclusive technology will meet the inevitable logics of neoliberal political economy, resulting only in the rich – big business and the already-powerful – benefiting, while the poor or excluded are

further marginalised. At a global level, this draws together concerns about a wealthy, consumer product-focused North enjoying both emerging technology and its benefits, while the global South is left behind; on a more local level, it is linked to concerns about the practicalities of ordinary people securing access to advances or consumer goods enabled by emerging technology. This narrative, with its normative emphasis on equal access to the benefits of emerging technology, encodes powerful notions of morality. Ideals of justice, fairness, and equality are thus used to critique nanotechnology's potential development.<sup>10</sup>

## Discussion

So far we have explored the stories that people draw upon in responding to emerging technologies. These narratives can be neither described accurately as group effects or as individual contributions; rather, they operate as resources that are deployed in a dialogic and interactive struggle towards a collective vocabulary to render novel science and technology culturally meaningful. Our proposed typology thus does not cover all public concerns, and there are certainly alternative narrative resources which people draw upon in the formation of public views and attitudes. We might point to the 'slippery slope' narrative (that technological advances that seem beneficial now will inevitably evoke further technological steps and applications that are morally doubtful); the 'colonisation' narrative (that technology will spread out and ultimately colonise autonomy and agency); the 'Dr Strangelove' narrative (that science designed for 'good use' will become corrupted and manipulated by evil people); and the 'Trojan Horse' narrative (that innovations developed for progressive purposes will in the long term have unforeseen and potentially irreversible effects) (see Macnaghten, 2010; Rejeski, 2007; Swierstra and Rip, 2007). Nevertheless, the five narratives identified in the DEEPEN project have emerged repeatedly and consistently in our research across a diversity of technological arenas (see Macnaghten, 2001, 2004; Kearnes, Macnaghten and Wilsdon, 2006; Macnaghten and Guivant, 2011; Macnaghten and Szerszynski, 2013), suggesting that they are a robust means of understanding how public attitudes to emerging technology are formed in guided social interaction.

The obvious question is why *these particular narratives* seem to be so central to the articulation of public responses to emerging technologies. Why these stories, and not others? It is on this question we want to reflect on in concluding, suggesting that it is important to relate public narratives to the politics of technological development, and to see them as a reaction to a dominant, neoliberal politics of technoscience which continually

limits public involvement in societal agenda setting (the question: what kind of future do we want?) to the role of the consumer. These narratives are called forth, in other words, by policy logics that emphasise inevitable technological progress and associated social gains, without any space for questioning the nature and reality of either the progress or the social effects.<sup>11</sup> It is this that brings forth a set of counter narratives which highlight the precariousness of positive social impacts from rapid technological change, and which almost inevitably end in reinforcing the tragic (inequality in 'the rich get richer'; or ecological or social disaster in 'opening Pandora's box' or 'messing with nature').

For Dupuy (2010), the five DEEPEN narratives are not independent of each other but should be grouped together into two metanarratives: one ancient, the other modern. The ancient metanarrative draws together the 'be careful what you wish for', 'Pandora's Box' and 'messing with nature' narratives. It is ancient because it explains the potential of ills and harms as the product of the transgression of norms and orders that hold a sacred or ontological quality, and where the standards of good and bad conduct transcend human affairs. By contrast, the 'kept in the dark' and the 'rich get richer' narratives are modern in that the fruits of science and technology are not put under scrutiny: it is simply that people are being excluded from decision-making processes ('kept in the dark') or that the benefits are unfairly distributed ('rich get richer').<sup>12</sup> Thus we could suggest that the formation of public attitudes to emerging technology depends on the interplay of three master narratives: an ancient counter narrative where the transgression of natural orders and boundaries (hubris) lead to ills and harms (nemesis); a modern counter narrative where publics are exploited and alienated through technology; and a dominant master narrative of scientific breakthroughs linked to social progress and the triumph of pure knowledge ultimately derived from the Enlightenment (see Felt et al., 2007). As Luigi Pellizzoni has argued, this dominant narrative is implied in neoliberal logics and relies on a reconfiguration of the biophysical world as not only fictionally but actually plastic: i.e. of nature as fully plastic, controllable and open to ever expanding agency (Pellizzoni, 2011). Our analysis of the 'tragic' quality of public narratives points to a collective rejection of this master narrative of science in guaranteeing social progress, and a failure of imagination of a tractable alternative in navigating science and technology in more environmentally and socially beneficial directions.

The key policy implication comes from the presence of these different politics of technology. Traditional approaches to governance have tended to rely on the dominant progress narrative, presuming that a technology should be permitted onto the marketplace

in the absence of evidence to harm (to human health and the environment), and as long as it does not violate basic ethical principles (such as privacy, liberty, freedom of expression and autonomy). But the public narratives we have described transcend questions of technical risk, and are only imperfectly captured in the language of basic ethical principles. Thus even though the 'counter narratives' identified in this paper appear deeply embedded in public opinion, they nevertheless have made remarkably little impact on public policymaking, which remains tied to the traditional Enlightenment framework.<sup>13</sup> Neither organized environmentalism (which is notoriously ambiguous about science) nor other social forces have been able to bring up these widespread public feelings and translate them into a consistent political action.<sup>14</sup> Indeed, even when technoscientific innovation has resulted in public controversy, such as that around genetically modified (GM) foods and crops in Europe in the late 1990s, institutional actors (including environmental NGOs) continued to rely on risk science as the arbiter, thus effectively hiding from public view and accountability the wider narrative framings of the issue at hand (Grove-White et al., 1997; Wynne, 2001). What this implies for science governance, and for environmental policymaking more generally, is the need to recognize the legitimacy and reach of these counter narratives.

Our final reflection concerns implications for those efforts aimed at responsible governance mentioned in the introduction, including those informed by the 'anticipation-inclusion-reflexivity-responsiveness' (AIRR) framework (see Owen et al., 2013; Stilgoe, Owen and Macnaghten, 2013). We suggest four spheres of intersection. First, in initiatives aimed at enhancing anticipatory governance, our approach points to the need for greater sensitivity to the narrative pathways through which emerging technology might plausibly lead to ills and harms (stories about the introduction of seductive but false pleasures, or the unequal distribution of benefits). Second, in relation to initiatives aimed at inclusive public engagement, our approach offers a way of understanding both the materiality of public concerns and their mediation through underpinning narratives. Understanding how concerns are mediated both by different cultural narratives (large and small) in a cross-cultural perspective, and, in addition, by the specific social constitutions of different emerging technologies is a necessary element of future inquiry. Third, in relation to initiatives aimed at enhancing scientific reflexivity, our approach points to the need to introduce reflexivity at the level of ontology and meaning: to help scientists and innovators understand how tacit assumptions of nature and social progress, often embedded in dominant scientific and policy discourse, may be radically at odds with wider public sentiment. Importantly, this may require interaction with a different range of disciplinary



competences: alongside ethicists, political scientists and public engagement specialists, this may necessitate creative interaction with the wider humanities, from theologians to historians to classicists to performance artists to literary theorists to cultural anthropologists. Finally, in developing institutional responsiveness, our approach necessitates the need for new kinds of responsive capacities in the science policy and regulatory regime, very possibly requiring institutional and regulatory redesign, that consider the broader cultural, societal and ethical dimensions of emerging technologies and that are equipped to help institutions change shape or direction in response to improved anticipation, inclusion and reflexivity.

To finish, it is worth introducing a note of methodological caution. Our research relies on an interpretation of focus group discussions that assumes how people talk in focus group situations can be taken as a proxy for wider 'public opinion'. This assumption is not unproblematic and the design criteria underpinning this research warrants further discussion. Nevertheless, given our collective need to produce models of anticipatory governance in line with societal values and as a counterweight to a market-inspired models of technological governance, we suggest that the development of narrative research is a task worth pursuing.

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## Notes

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<sup>1</sup> Even though this paper focuses on the role of narrative in understanding public responses to emerging technology, we suggest our narrative approach has wider application, both in the analysis of the sociotechnical imaginaries (i.e. narratives) embedded in the material practices of scientific and technological innovation (Fischer 2003; Jasanoff 2005; Marcus 1995), and in the analysis of the

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narrative resources that mobilise action and practice in contemporary environmental politics and policy.

<sup>2</sup> While there are subtle differences in methodology across our research projects, and an evolution of approach over time, these are relatively minor and secondary to the common design principles described here.

<sup>3</sup> Each of our focus group projects began with relatively open-ended conversations on issues that were deemed as contextually important for the issue at hand. For the project on GM crop and food technologies the key context was deemed to be everyday food practices; for the project on animal biotechnology the context was people's wider experience of, and relationship with animals; while for the project on solar radiation management the focus groups began with an open-ended discussion on experience of the weather and the climate, designed to provide a context for future deliberations on geoengineering as a climate change modification technology.

<sup>4</sup> Our narrative analytical account has a number of parallels to formal accounts of discourse analysis (see Potter and Wetherell, 1987). Like discourse analysis, our approach aims to identify theoretically-based structures that underpin local patterns of expression. However, unlike discourse analysis, our approach is equally concerned with what is said (i.e. the story) as with how it is said (i.e. the discourse).

<sup>5</sup> We are grateful to Steve Hilgartner for elaboration of this point.

<sup>6</sup> Interestingly, the 'be careful what you wish for' narrative was rarely deployed in discussions of other emerging technologies. The implied benefits of agricultural and animal biotechnologies (e.g. feeding the world, improved disease resistance), for instance, tended to be rejected as implausible under current conditions of political economy; thus they rarely held a seductive character. Similarly, there was little seductive appeal in geoengineering technologies; at best these were technologies that would help prevent the further and possibly impending disaster of runaway climate change.

<sup>7</sup> This narrative was also very frequently used in public discussions on agricultural and animal biotechnologies, and on solar radiation management, technologies that were frequently seen as likely to 'get out of the box', and to contribute to unforeseen and potentially irreversible harms.

<sup>8</sup> In public discussions on animal and plant biotechnology this narrative was also frequently deployed. Plants and animals had evolved over long timescales and to propose that one could improve characteristics in the laboratory on a more or less 'instantaneous' basis appeared to many respondents as arrogant (hubris) and as likely to rebound on humans (nemesi), especially if the 'speed' and 'direction' of such developments are driven by commercial rather than ethical considerations. In discussions on solar radiation management the 'messing with nature' was perhaps the core narrative resource structuring public responses. Since science was commonly seen as lacking the capacity to anticipate harms in advance, this pervasive experimentality was seen to be part of the new human condition.

<sup>9</sup> This narrative was frequently deployed across all our research projects, speaking to a commonly felt lack of public agency in shaping science and technology innovation trajectory in line with public values.

<sup>10</sup> This narrative was used to inform public concerns across all the research projects although it was most common in discussions of technologies that were seen to have most potential to concentrate power and wealth, such as nanotechnology and crop biotechnology.

<sup>11</sup> Of course, neoliberalism as a phenomenon in policymaking, with its emphasis on the state in enforcing ideals of market liberalization, has its own narrative and history that Laurence Busch (2011) dates rather precisely to the 1930s.

<sup>12</sup> We are not suggesting that notions of equality and of being 'kept in the dark' were not features of ancient thought. They were. Nevertheless, following Marx and Weber, we are suggesting that modern thought and practice is far more intimately connected to the trope of alienation (e.g. through processes of increased rationalization, secularization, specialization and the bureaucratization of social order), and that the modern idea of social equality (i.e. that individuals and groups of individuals are treated fairly and equally irrespective of gender, age, race, creed and class) was enabled in the modern age and only through the great revolutions of the 18<sup>th</sup> century in America and France.

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<sup>13</sup> We are grateful to Luigi Pellizzoni for elaboration of this point.

<sup>14</sup> It is argued that the 'precautionary principle' is not immune from this critique. The precautionary approach fits within this technocratic model of governance given that it relies on a scientific analysis of potential harm (even in the absence of scientific consensus) to avoid a particular action or policy from being taken.