The challenges of "upstream" communication and public engagement for Irish nanotechnology

Dr. Pádraig MURPHY
Research Fellow,
School of Communications,
Dublin City University,
Glasnevin,
Dublin 9,
IRELAND
+353 1 7007703
padraig.murphy@dcu.ie

Abstract This paper sets out some challenges for Ireland's contribution to nanotechnology public engagement in the context of current STS and science communication theoretical-practice approaches. I report on a pilot set of public engagement activities and accompanying 'multi-sited ethnographic' and frame analysis methodologies. I reflect on how the theoretical context of these methods and findings present a challenge for nanoscience communicators in the first instance, but also for the social scientists and academics that are themselves contributing to the discourse of nanotechnology and, intentionally or not, communicating nanotechnology to diverse publics. I identify six discourse sites of nanotechnology which have the potential for public engagement.

1. Introduction

As in many other countries, nanotechnology has been presented as offering huge potential for Irish research and development, leading to life-changing possibilities. However there is a lack of awareness and little public discourse in Ireland about these technologies. Globally, there is some concern, particularly about the unknown effects on health and the environment. Concerns have arisen about, for example, the potential toxicity and environmental impact of nanoscale materials in food and healthcare. Smaller particles are said to have larger surface reactivity, having both environmental and health implications. In the EU and US, public consultation processes have begun to gauge opinion and facilitate public involvement in decision-making. However, there is more to nanotechnology communication than the standard opinion-gathering step in a process that leads towards public acceptance. Much recent attention across Europe has been on the use of "upstream" models of communication using sets of public engagement exercises involving scientists and various publics at an early stage of decision-making [1], [2]. There is growing opinion that other risk perceptions besides those offered by scientific evidence must be engaged with through consultation and must occur *before* regulation, policy or development. While health and environmental risk factors are drivers for assessment, the possibility of allowing more nuanced public concepts of "risk" into early discussions also occurs in upstream literature [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [12]. In addition, a report by Demos, the UK democratic think-tank looking at scientific governance and social issues, proposes that risk is just one part of public discourse on scientific innovation and policy [6].

This paper draws from this movement away from emphasis on risk assessment and thus will not seek to immediately disentangle perceived ideas of "health risk" from "environmental risk," and in turn each of these perceptions from others based on "ethics," "social concerns," or "future imaginaries" [8]. Imaginaries are a particular upstream form of analysis. Future-oriented narratives are common in media representations of nanotechnology, fictional and otherwise [13]. Placing the domain of future possibilities and visions into contemporary discourse opens up a different type of conversation. Writers such as Hayles [14] and Milburn [15] refer to the transcendent power of nanotechnology, rather than its more mundane practical applications, and these themes are seen in sci-fi blogs, film and advertising. However, increasingly, the transcendence of future scenarios are brought into what Erickson [13] calls "formal science" or science educational spaces [16], [17].

Speculative narratives and concerns from science fiction, fan fiction and comic-book popular culture and other forms of cultural imagination are part of what might be called the *media practices* [18] which engage with nanotechnology, using embedded popular cultural understandings of a concept. In fact, these fiction-orientated arenas may deal most prominently with some sense of risk or concern, perhaps the most (in)famous being Bill Joy's [19] references to a "grey goo" scenario. Rather than considering such concerns as outlandish and outside the terms of debate, understanding media practices of the "cultures of nanotechnology" might focus away from traditional "risk assessment" and instrumentalist ideas of public concerns about technology—occurring "downstream," where major decisions are already made and where concerns can be simplistically quantified—and bring public participation closer to the sites of innovation where publics feel they have a voice in the eventual policy and regulatory

outcome. The point put forward by proponents of upstream communication is that perceived lack of awareness of risk factors or indeed anything to do with nanotechnology is not enough justification to sustain low levels of *dialogic engagement* in favour of increased *information transfer* [11]. However, the promise of upstream communication has been tempered by criticism [20], some of it coming from within the community itself, particularly of the challenge of meaningfully creating the space where upstream input might occur, unrestrained by the potential for strategic framing of activity outputs by their designers and facilitators [21]. This paper suggests that these early stages of upstream nanotechnology communication should examine carefully at how nanotechnology is currently being talked about.

The project on which this paper is based will test some communication models and analyse knowledge domains in the process. The wider project is a post-doctoral fellowship under the Health and Environment theme of the Irish Environmental Protection Agency (EPA) STRIVE programme at the School of Communications, Dublin City University (DCU). It will specifically draw attention to public participation and responses around connected environmental, health and ethical issues regarding nanotechnology, while a final report will inform policy-makers about the social acceptance of such technologies and nanotechnology policy in Ireland. The project endeavours to map the rules of mediated talk where nanotechnology communication may take place. This mapping will contribute to the understanding of various Irish publics—including nano experts—of nanotechnology as a bounded object within distinct sites of discourse, and exploring the communication possibilities of this emerging nanotechnology field within these sites.

These new discursive public participation approaches to science and technology have only recently been looked at by science policy-makers in Ireland. Forfás, the advisory board to the Irish Government on science, technology and innovation, is currently undertaking a consultative technology assessment of nanotechnologies, called NanoIreland [22], to aid public policy decision-making, gathering stakeholder and wider public views of societal, economic and scientific dimensions of the field. This report is due in 2008.

There is also a reflexive side to this paper. There is an obvious knowledge vacuum and this presents challenges for the qualitative researcher of nanotechnology communication in Ireland where such research becomes, in itself, a form of nanotechnology communication. During the course of this project, I, as researcher will inevitably speak to people who may never have encountered the term "nanotechnology" before and interact with stakeholders who are unfamiliar with contemporary methods within the social sciences. Testing communication and public engagement models in a field in which there is as yet little public knowledge requires some explanation of current scientific thinking as well as acknowledgement of the futuristic narratives of nanotechnology common to media representations.

Before clarifying the aims of this paper, let us consider wider science communication concerns. This paper and the wider project contribute to the ongoing question—why communicate nanotechnology? The contingencies and hybrid nature of nanotechnology allows those of us working in a public engagement role to ask fundamental questions, just as other sites within the field must also do, such as: What is

the purpose of public engagement? Is it enough to justify in terms of democratic inclusion of publics in science and technology governance, or for greater public trust and scientific accountability? The recommendation here for those of us operating in a dual role within qualitative research and science communication is to reflect on both the legitimacy of nanotechnology communication and the complexity of the topic for all publics.

The communication of nanotechnology then can be seen to be a challenge on two levels:

1. for the *communication of the science of nanoscience and nanotechnology* as 'a body of knowledge', while dealing with issues relating to the use of nanotechnology, some of which are problematic but which is often placed within a strategic international and economic rationale, or drawing paradoxically from science fiction and popular culture narratives;

2. for those of us who use *qualitative inquiry methods in various forms of action research* to investigate more generally new types of scientific engagement, of discussion, of hybrids, of practices, and who use nanotechnology as an exemplar, thus reflexively become part of the public engagement of nanotechnology, implicitly or otherwise promoting as we inquire.

Although there is a strong—albeit ambiguous—relationship between these two positions, it is the second of these types of challenges that sets the main context for this paper. This is a field in which the researcher undoubtedly contributes to the story.

It is within the above context that this paper addresses the issues of nanotechnology public engagement for the "boundary work" researcher. The aims of this working paper are:

- to reflect on the dual role of the nanotechnology communicator/ researcher associated with the theory and practice of the field
- to theoretically address the context for a type of inquiry into nanotechnology communication that favours the turn towards 'practices' in the social sciences;
- to report on preliminary empirical findings using frame analysis of six *discourse sites* in which the publics may engage with nanotechnology and the implications;

Each of the discourse sites listed below were selected on the bases that they are arenas of practices that order local knowledges, whether through describing or summarising a strategy or phenomenon or allowing publics to either access, respond to, or contribute to nanotechnology science and corresponding knowledge co-production of societal implications. The focus is the practices in each site that allow discussion about nanotechnology and sets the terms of discourse and how discursive interrelations between theses site practices construct the concept of risk. These sites contain the discursive practices of policy, news media, fictional narratives, community development and education, some of which may currently provide barriers to public discourse, not being highly visible in the public domain, while for others public engagement is their *reason d'etre*.

2. Theoretical Context

An overarching theoretical approach is that of "practices", as utilised in Science and Technology Studies (STS) among other fields, exploring the doings, sayings and ordering of things [23] within contexts which have their own cultural rules, ideas and meanings, while also taking on board discursive practices in representation. The concept of practices is a contemporary social theory view of science and technology, principally those theorists who look closer at power and ideological processes by exploring the embeddedness of practices, crucially common, *everyday practices*, such as Giddens [24], Bourdieu [25], and Boltanski and Thevenot [26], [27]. Schatzki [28] refers to practices in their broadest sense as "arrays of activity" that construct intrinsic "moral guidelines" for routine actions and tacit knowledges. Practices are organised activities involving a particular group, or groups of publics. They are caught within a discourse or set of discourses, as defined in the Foucauldian sense of social constraint by Fairclough [29] and are highly dependent on various media.

The term "site" is used here in the context of Schatzki's work on site ontologies. It is an intersection of discourses where particular practices may be identified that set parameters. A site is a context, where backgrounds determine phenomena. Schatzki describes sites as "arenas or broader sets of phenomena as part of which something—a building, an institution, an event—exists or occurs (pp467-468) [30]". A site is thus not just a spatial boundary; it can be a political site of activity, a school or an online chatroom. Sites are places of interaction, such as practices of "outreach and education," of economic rationale, and indeed, of media, where media rituals [18], [31] and "issue cycles" [10], [32] form part of the currency of science controversy, opinion columns and business reporting. Sites are somewhat analogous to other STS terms for intersecting practices such as "entanglements" [33] or "mangles" [34]. At certain points where these sites exist, there is the *potential* for publics to *talk about* nanotechnology, if not directly input to wider discourses. The explicitly social nature of practices and sites must be emphasised. People talk in these sites (Latour would say, "things" do also [35]), and imagine future scenarios. This is one of the objectives of upstream processes of nanotechnology communication—to use imaginaries:

> Imaginaries….dissolves the opposition of the imagined and the real: whether an imaginary is based in fantasy or in evidence remains an empirical question rather than one to be settled *a priori* (Marcus, 1995 [36]; Verran, 1998 [37]). The key point is, imaginaries are materially powerful; they do shape practices, relationships, and commitments (which are often rendered irreversible), and as such, they demand reflective, accountable attention and debate [8].

When addressing practices of meaning and cognitive schema on nanotechnology at the everyday "cultures of practice" level, it is useful to look at similar practice ideas from Ulrich Beck [38], [39] and his idea of the "risk society," and Eder's [40] cognitive/cultural framing of ecology. In these texts, there is increased public awareness of risks and uncertainties associated with technology and future planning demanding increased choosing and decision-making by citizens in late modernity, that

is, an age of increased technological change, mediation, consumption and globalisation. Habermas [41] also observes that, in this context, normative decision-making for emerging technologies cannot be seen in terms of *formal* moral reasoning. These decisions involve a perspective on nature and the environment [24], [38], [39], [42] grounded in assumptions about everyday life. Common, assumed practices within regions, locales and sites are therefore important particularly for a so-called transformative technology such as nanotechnology.

How can recent concepts in science studies and science communication, such as practices, be applied to Irish science communication, specifically to emerging nanotechnology communication? How does one bring about discussion in science communication and policy practice about common terms from STS that reflect the breakdown of borders such as "hybridity," "co-production," "symmetry" and "boundary objects," particularly in policy spaces where consensus is more often the requirement? Could these terms ever be considered reflexively, perhaps as a necessary social science perspective, as argued by Macnagthen *et al* [8]? Can they be explicitly engaged with by science communicators and STS theorists alike? To consider these issues is nothing less than bringing decidedly Latourian notions into an Irish context for science communication.

There are no calls here for public engagement "explainers" and science communicators to become STS experts or contemporary ethnographers. However, attention to sites and practices, learning from spatial and no-spatial contextualisations of "knowledge production" is important for nano-communicators, to learn from shared practices in each site.

In the context of issue cycles, where controversy generally drives connecting inter-media and public discourse knowledge production over a finite time, nanotechnology may not yet fit the bill in Ireland. Does something fail to become an issue until it becomes a controversy? It could be argued that, globally, nanotechnology does not energise debate to the same extent that GM food, climate change or nuclear energy has in the past, with the exception of Magic Nano or the odd food or soil additive. Perhaps it is a case of no controversy, no issue. Could the logical extension of this then be, as Latour [43] says, quoting Marres, "no issue, no politics" (p4)? However nanotechnology may not necessarily be operating in a discursive vacuum within the six sites identified by this paper in the sections below.

To address what practices may be involved at a local level, we can look into laboratories or nanotech facilities [4]. But to investigate further out into discourses of health and environment, we need to look into media processes and into "practices of talk," conversations and discussion as practices. These are the *practices* involved in talking, mediated talk, talk as action, media rituals and the "politics of talk," as Irwin [7] describes it. It may include common talk. In addition, although Fairclough [29] traces a move in media discourse towards "conversationalism" (p11), a shift from formal discourse to everyday talk which creates a tendency towards both democratisation and marketisation of difficult concepts, the sites of formal representation of nanotechnology knowledge are important. However, is there *any* public talk occurring about nanotechnology?

Even within a talk vacuum, where the concept of nanotechnology is introduced for the first time—such as in the school sites as described briefly below—"cognitive devices" aid in constructing frames of meaning [40] for nanotechnology. Publics use these to construct dichotomies of nature versus technology (health and environmental discourses), or construct moral practices of ecological discourse, whether through social movements or connecting to everyday life, or in "cosmopolitics" or the "good, common world" [35], or macro/micro connections in the manner of Boltanski and Thevenot's [26] six *regimes of justification* or *orders of worth.*[1] Nanotechnology is just one type of concern about 'humanity versus nature'—another is reproductive and genetic technologies [44]—in what many sociologists have described as a changing period of modernity where individuals, corporations and Governments are being called on to make big decisions regarding technology and nature. Publics may well use a pragmatic *moral of the every day* [45] to apply to emerging technologies such as nanotechnology. The type of theoretical lens just described allows us to look at the ethical, or more accurately, *moral* standards utilised by each group of "stakeholders" and actors, through distinctive discursive practices, as they may apply to these early stages of debate about nanotechnology in Ireland.

For Leach *et al* [46], a new type of public engagement must also address power:

> It has increasingly been recognised….in both the sociology of scientific knowledge (eg Verran 2002 [47]) and anthropology (eg, Strathern, 1999 [48]) that [public engagement] is a matter of incommensurable practical human-cultural ways of being (ontologies), not only of different human epistemologies or preferred ways on knowing …[These are] those conflicts between powerful institutions acting in the name of scientific rationality and publics [and] have thus been recognised as less a reflection of public ignorance and irrationality and more a reflection of different frameworks of meaning within which salient observations and propositional beliefs are defined and given standing (p8) [46].

Stirling [11] gives three reasons for public engagement with science and technology and public participation: 1) *normative*, which are notions of equity, social justice, distribution of power; 2) *instrumental* — incumbent interests, a way of achieving better ends and gathering social intelligence; and 3) *substantive*—social robustness, quality of choices, how the whole process *has* better ends as well as sensitivity to epistemologies and ontologies.

Irwin [7] tells us that old assumptions about the "innocent citizen" emerge in upstream models: "stresses and strains within the politics of public talk assume wider

---

[1] Boltaski and Thevenot's six regimes of justification are civic, market, transcendence, fame/renown, industrial, and domestic.

analytical significance than the 'mere talk' epithet would suggest" (p299). He suggests a move from the STS-influenced discourse about public engagement (as it occurs in the UK) to one of robust analysis and justification, so that public engagement is not justified for its own sake, where it may be perceived as a noble failure if it runs aground. He suggests his own reading of a dual-purpose model at work—a belief in modernist progress augmented by dialogue [7]. A loaded mechanism of technoscientific framing of upstream processes has led the facilitator of the UK-based Nanojury to remark that upstream matters less when the stream is already "polluted" [21]. It is envisaged that examining conflicts and commonalities across nanotechnology discourse sites will tell us more about the intentions of publics inside or outside such processes, at varying levels

3. Methodology

This paper identifies sites and practices through which particular types of concept framing occurs. The method of inquiry for this paper is a preliminary analysis through multi-sited ethnographic notes [49] examining the "performative idiom" of ontologies in these sites rather than an epistemological idiom [34], that is, understandings in practices rather than beliefs. Fieldnotes for a site such as a school listed a network of nano props, lesson plans, students, school spaces, facilitators and teachers. A way of tracking a story in this ethnographic sense is also considered here. Part of this approach involves considering the qualitative experience of what nanotechnology means for Irish people in 2008. An ethnographic content analysis approach [50]was used as a preliminary step for public affairs media. The search words "nanotechnology," "nano-technology," "nanoscience," "nano-science," "nanoscale," "nano-scale" and "nano" were entered into LexisNexis for four Irish publications and the print versions validated for the period January 1st to May 1st 2008. Sixteen articles only were identified.

In addition, I carried out a preliminary frame analysis of discourse sites identified below. Frame analysis involves the identification of patterns and interpretive boundaries in discursive moments, whether the strategic emphasis and omission of matters of fact in media reporting [51], [32] or the organisation of 'packages' of meaning about situations and activities in audience talk [10] , [52], [53].

To further capture the changing nature of nanotechnology as a "bounded object," it is proposed that we can "follow" a concept in a defined timeline through such discourse sites. This is a type of multi-sited ethnography as outlined in the first instance by Marcus [49], but also Mol [54] and Hine [55]:

> Multi-sited research is designed around chains, paths, threads, conjunctions, or juxtapositions of locations in which the ethnographer establishes some form of literal, physical presence with an explicit, posited logic of association or connection among sites that in fact defines the argument of the ethnography (p90) [49].

I "followed the thing" or "followed the story", in line with Marcus's [49] idea of a multi-sited ethnography. The "object" in and of the research is followed through each site, be it public affairs media, connected blogs or in school references, whether in non-interventionist observer capacity—in the case of public affairs media, or as participant observer—in the case of schools. Hine [55] refers to Marcus' understanding of the "multi-sited imaginary," changing forms through local and global cultures:

> The multi-sited imaginary is a way of capturing the need which has increasingly been expressed for forms of ethnography which do justice to the complex patterning of contemporary life (p656 [55], quoting Marcus, 1998, p14 [49].

The remainder of the fellowship project will explore interactions between the six sites through practical upstream public engagement activities from sites 5-6. In the next section of the paper, there is a brief examination of the use of the six sites as areas of analysis drawing from empirical data from policy documents, online forums and the author's fieldnotes on school outreach visits and a citizens' jury pilot. In describing the "action research" interventionist discourse sites below, I wish to draw attention to how they are set up for future public engagement activities.

4. Results and Discussion: Describing Discourse Sites

Following Schatzki's definition of a "site" in his theory of practices, *six discourse sites* have been identified in which to track framing patterns about nanotechnology in potential public engagement settings, each with varying focus on national or international affairs, with the author participating in three of them (indicated below). These are the discourse sites where either some form of *public access* or *public engagement* has the potential to occur in Ireland. Other sites have been excluded, referred to later, on the basis that they have not yet been considered at the level of public consciousness. The discourse sites are:

- *Business, industrial, technoscientific (local/international)* - relationships between knowledge economy interests and nanotechnology facility developments in shared networks of practices, outreach, etc;

- *Policy (local/international)* - organisation and policymaking around nanotechnology in national and international contexts;

- *Public affairs media (local/international)* - drawing attention to the amount and extent of media coverage on nanotechnology and media practices

- *Fictive and Web 2.0 ephemera (local/international / wider cultural) [including action research through author's activities]* - identifying a trend within the culture of nanotechnology where science fiction and

futuristic narratives are used, prominently on new web forums, and indeed where there is overall, an ambiguous relationship between nanoscience and culturally–embedded concepts from science fiction realms [13],[14], [15], [16], [17], [56].

- *Schools and educational (local) [including action research through author's activities]* - opportunities to look at the introducing teaching materials at second level education; interaction of educational and other discourses;

- *Community forum and citizens' jury (local) [including action research through author's activities]* - exploring the potential for a local community-based approach to nanotechnology decision-making, or at least, nanotechnology discussion

In describing the six sites of discourse in this project, both commonalities and distinguishing features of local practices from each site add to the complexity of engagement with nanotechnology, regardless of the level of awareness or technical understanding. Sites draw on common assumptions and understandings within the rules of engagement; a newspaper article demands a story, a Government policy site describes strategic relationships with business rhetoric, a sci-fi blog may use coded messages about a recent popular book or aspirations to scientific authority. Munshi *et al* [57] have identified similar categories which they have called "nodes" or "islands" of discourse. In contrast to the global discourses they describe, this paper focuses on those sites of greater public access in a local Irish context. For that reason, "political activist" and "social science" nodes are, unfortunately, missing here, given the absence locally of these potential sites, and accordingly we are missing potential risk talk.

In an example of "following the object" [55] through some of these sites, the "object" presented here is a story about a particular nanotechnology building space. In January 2008, the opening of the Naughton Institute at Trinity College Dublin, which also houses what has been declared as the world's first Science Gallery. This opening created the conditions for nanotechnology discourse to mix into other spheres of discourse—art , fashion, entertainment—while remaining centred on one institution, with an *event*, a sense of *place*, and presented as having *strategic national importance*. Watching how this research object presents understandings of nanotechnology across various site contexts tells us something about nanotechnology's multiplicity as well as its links from policy to publics and common frames of meaning across sites.

In terms of common areas of understanding, there are strong interconnecting frames emerging from preliminary analysis that cut across the first four discourse sites under study—policy, public affairs, technoscience and fiction. Two prominent discourse frames of policy and public affairs media are the *economic* frame and the *progress through nature* frame. For the former, there is an economy-driven rationale for the research and development of nanotechnology in the EU and US policy documentation. For the latter, discussions have drawn from Drexler's [58] original framing, with terms such as 'conquest' and 'control' being prominent, and using nature's own devices to improve processes that are continuously described as 'natural.'

Progress frames often invoke science fiction utopias, thus linking to similar framing in public affairs media and of course, science fiction itself.

Given the focus in this paper on nanotechnology as a space for discourse, understandings of nanotechnology in scientific terms or in describing potential negative effects or risk factors are of particular interest, as well as the role for public engagement. In all of these areas of focus within the policy literature, there is little debate, yet no clear consensus either.[2] For policy-makers, uncertainty is high in terms of actual future impacts and the technology's role in public discourse. However, policy-makers appear to be in a position in Ireland —and indeed under pressure—to consider how nanotechnology may be communicated, both to Government exchequer and to publics. However, with the opening of the Naughton Institute and adjoining Science Gallery a form of nano communication may already be subtly beginning.

It was possible to track practically all references to nanotechnology to the opening of the Naughton Institute and issues associated with its physical location and strategic importance (As examples, consider the following article content: part of the roof fell into the street; this part of the city has been derelict for years; Irish technology economy depends on this institute, housed in Trinity College Dublin.).

There are, of course, major differences in the world of nanotechnology presented across sites. While there is a relationship between public affairs media, academia and the technological and cultural industries for instance on a shared vision of what Milburn [15] calls the "technoscape"—which fetishises the transcendent, nanoscopic world of atoms and circuitry [59]—this can be contrasted with the mundane descriptions of nanoscience in policy documents. The strong, original sci-fi vision from Drexler [58] to Kurzweil [60] has done much to shape a common understanding across scientific fields, which can either be drawn on to aid description, or undermined depending on the context.

Dunwoody [61] made an early creditable claim about the power aspect of media and risk discourse:

> Sometimes a community is geographically bounded, as is the case with the readers of a typical city newspaper, who have in common a few square miles of territory. At other times, … community members may be widely dispersed but held together instead by shared values, as is the case with subscribers to an advocacy publication; they may be spread around the globe but hold common beliefs about an issue or a set of larger concepts such as the environment. At any rate, the crucial dimension of a community is not geographic; it is the extent to which power is centralized in that community (p1) [61] .

---

2 The main uncontested boundary is the 'under-100nm' rule for describing nanotechnology, although Munshi *et al* [57] have identified East/West distinctions here.

What is also powerful about the practices of sites, is that risk talk can be entirely absent from the discourse, as is the case of Irish public affairs media, policy and technoscience.

Two other discourse site reported in this project, removed from the "followed object" of the Naughton Institute/Science Gallery, was a pilot citizens' jury, which was run in Dublin City University on May 16th 2008, and school-based forums. For the citizen's jury, a nanoelectronics professor and a healthcare ethicist presented contrasting visions of nanotechnology to a local community group leaders who formed the "jury", with the scientist promoting the technology and the ethicist presenting a precautionary case. Although the main challenge was getting critical mass of social workers to attend, the 'verdict' raised some interesting perspectives which may challenge current science communication strategy in Ireland, such as concerns about 'nano knowledge' never reaching the disenfranchised; inequity of knowledge domains; an understanding of how society generally adapts to new technologies , but it is issues of trust in the policymakers that is most at issue; and concerns about how policymakers and publics might acknowledge the local/global issues regarding the regulation, control and consumption of nanotechnologies. These issues all appear far removed from science fiction visions and are tied into local everyday practices and concerns of community development.

For school forums, activities such as podcasts, news reports and debates were used as novel ways of communicating the complexity of nanotechnology as a discourse to young people. Using this discourse approach allowed frames to emerge from their discussions that were categorically different from those appearing in the policy and public affairs sites, for example *risk*, *runaway*, *liberal individualism*, *social responsibility*, *progress* and *harmony with nature*. These appear to be largely absent from Irish policy, public affairs and technoscientific sites. In pilot sessions with secondary school students, the *economy* frame, curiously, can be observed as a construction of facilitator or teacher interventions, not student contributions. Other emerging frames included *paternalistic military*, potentially related to US defence web material on nanotechnology, and the indecisiveness of many students regarding whether nanotechnology is an *alien object*, as signified by medical nanobots, or a *non-object*, an intangible more abstract concept.

5. Conclusions and further work

The preliminary empirical findings reported here show just snapshots of the possible interactions and contradictions that occur throughout the framing mechanisms of particular discourse sites that I have identified for Irish nanotechnology. The overwhelming discursive framing for nanotechnology in Ireland appears to be an economic one, driven by a strategic hierarchy within policy, technoscience and public affairs media sites. However other frames are prominent in other less strategically placed discourse sites, for example schools, local communities and underground web forums. The citizen jury, in particular, raised many global science governance questions well beyond one group of technologies.

I have placed these empirical realms into a theoretical and reflexive context of a turn towards "practices" in the social sciences an the dual role of the nanotechnology communicator/ researcher. Wider questions emerge: What is the future role of the nanoscience and nanotechnology communicator/STS researcher? Can a move away from the elite discourse of science and the ephemeral of sci-fi blogs be part of this role? What of local communities who may have not have heard of, much less care about, nanotechnology? Can both common and distinct practices in the social theory sense be observed in Irish nanotechnology communication and public engagement? More specifically, what are common frames and contradictions within each discourse site and their attending set of practices?

Regarding the more strategic sites of policy, public affairs and technoscience, there must be extended work on the fulcrum that is public affairs. Without perpetuating what Couldry [18], [31] calls the myth of the mediated centre, the embeddedness of media ensures that public affairs media is a central site. It is a key barometer for ideas, opinion and ideological biases towards the concept of nanotechnology. However this site requires an event to hang it on, like the opening of the Science Gallery referred to here, or the publication of the now-delayed NanoIreland report. Public affairs media also includes of course current affairs TV, and radio and online broadcast news.

For the more ephemeral discourse sites, the poststructuralists in particular are beginning to look toward the nanotechnology phenomenon and the dialectic discourses of science fiction and future imaginaries. For other less strategic sites, upstream communication is seen to have its weaknesses, particularly, as Singh [21] states, it might be in danger of creating a new deficit model of assuming lack of trust.[3] A citizen jury can be combined with more equal status models, such as an issue engagement group exercise, successfully administered in the US as part of "attitude research" similar to Gamson's [52] or Macoubrie's [32] models. But we need to be careful about how we look at talk. Irwin [7] warns about old assumptions about the "innocent citizen" which emerge in upstream models: "Stresses and strains within the politics of public talk assume wider analytical significance than the 'mere talk' epithet would suggest (p299)".

For the two challenges of nanotechnology communication strategy then, as identified in the opening paragraphs: 1) the national strategic rationale may benefit from a sense of place and occasion, while spaces like the Science Gallery can offer a more discursive approach; however for 2), the reflexivity in communication processes needs to improve, that is a recognition of multiplicity in meanings and practices. In addition, the "counterdiscourses" of Web 2.0 or highly contextualised forums such as isolated community groups have yet to be seriously concerned by these communication strategies.

---

[3] For other critiques of uncritical and over-reaching upstream approaches see Irwin [7] and Collins and Evans (2002)

References

[1] Kearnes, M. 2005. Chaos and control: nanotechnology and the politics of emergence. [Online]. Paper submitted to *Paragraph*. Available from: http://www.sustainabletechnologies.ac.uk/PDF/project%20reports/110_2.pdf. [Accessed 19 September 2008].

[2] Wilsdon, J. and Willis, R. 2005. See-through science: why public engagement needs to move upstream. [Online]. London : Demos. Available from: http://www.demos.co.uk/files/Seethroughsciencefinal.pdf. [Accessed 19 September 2008].

[3] Allen, T.J. 2008. Nanotech: tiny particles, big risks. [Online]. *In These Times*. Available from: http://www.inthesetimes.com/article/3483/nanotech_tiny_particles_big_risks/. [Accessed 19 September 2008].

[4] Doubleday, R. 2007. Risk, public engagement and reflexivity: alternative framings of the public dimensions of nanotechnology. *Health, Risk and Society*, 9(2), pp211– 227.

[5] Grove-White, R. Macnaghten, P. and Wynne, B. 2000. Wising up: the public and new technologies. [Online]. Centre for the Study of Environmental Change. Available from http://www.csec.lancs.ac.uk/docs/wising_upmacnaghten.pdf. [Accessed 19 September 2008].

[6] Kearnes, M. Macnaghten, P. and Wilsdon, J.2006.*Governing at the nanoscale: people, policies and emerging technologies*. London : Democs.

[7] Irwin, A. 2006. The politics of talk: coming to terms with the 'new' scientific governance. *Social Studies of Science*. 36 (2), pp299-320.

[8] Macnaghten, P. Kearnes, M. B. and Wynne, B. 2005. Nanotechnology, governance, and public deliberation: what role for the social sciences? *Science Communication*, 27, pp268-291.

[9] Nanotechnology Engagement Group. 2006. Nanotechnology Engagement Group: Policy Report 1. Available from: http://www.nanoandsociety.com/ourlibrary/documents/NEGPolicyReport1.pdf. [Accessed 19 September 2008].

[10] Scheufele, D. A. and Lewenstein, B. V. 2005. Of public and nanotechnology: how citizens make sense of emerging technologies. *Journal of Nanoparticle Research*, 7 (6), pp659-667.

[11] Stirling, A. 2005. Opening up or closing down?: analysis, participation and power in the social appraisal of technology. *IN:* M. Leach, I. Scoones, and B. Wynne (eds.) *Science and citizens: globalisation and the challenge of engagement*. London and New York : Zed Books, pp218-231.

[12] Wynne, B. 2005. Risk as globalising 'democratic' discourse?: framing subjects as citizens. *IN:* M. Leach, I. Scoones, and B. Wynne (eds.) *Science and citizens: globalisation and the challenge of engagement*. London and New York : Zed Books, pp66-82.

[13] Erickson, M. 2008. Small stories and tall tales: nanotechnology, science fiction and science fact. *IN:* A. R. Bell, S. R. Davies and F. Mellor (eds.). *Science and its publics*. Newcastle: Cambridge Scholars Publishing , pp135-156.

[14] Hayles, N. K. 2004. Connecting the quantum dots: nanotechscience and culture. *IN:* N.K Hayles (ed.). *Nanoculture: implications of the new technoscience*. Chicago : University of Chicago Press, pp11-26.

[15] Milburn, C. 2005. Nano/splatter: disintegrating the postbiological body. *New Literary History,* 36, pp283–311.

[16] Brake, M and Thornton, R. 2003. Science fiction in the classroom. *Physics Education*, 38 (3), pp31-34.

[17] Thurs, D.P. 2007. Tiny tech, transcendent tech: nanotechnology, science fiction and the limits of modern science talk. *Science Communication* 29, pp65-95.

[18] Couldry, N. 2004. Theorising media as practice. *Social Semiotics,* 14 (2), pp115-132.

[19] Joy, B. 2000. Why the future doesn't need us. [Online]. *Wired,* 8 (4). Available from http://www.wired.com/wired/archive/8.04/joy.html. [Accessed 19 September 2008].

[20] Hornig Priest, S. 2005. Commentary - room at the bottom of Pandora's Box: peril and promise in communicating nanotechnology. *Science Communication* 27, pp292-299.

[21] Singh, J. 2005. Polluted waters: the UK Nanojury as upstream public engagement. [Online]. Discussion paper. Available from: http://www.nanojury.org.uk/pdfs/polluted_waters.pdf. [Accessed 19 September 2008].

[22] NanoIreland. 2006. (Homepage). [Online]. Available from http://www.nanoireland.ie/. [Accessed 19 September 2008].

[23] Swidler, A. 2001. What anchors practices? *IN*: T.R. Schatzki, K. Knorr-Cetina, and E. von Savigny (eds) *The practice turn in contemporary theory*. Routledge : London and New York, pp74-92.

[24] Giddens, A. 1991. *Modernity and self-identity: self and society in the late modern age*. Cambridge, UK: Polity Press.

[25]Bourdieu, P. 1990. *The logic of practice*. Cambridge : Polity.

[26] Boltanski, L. and Thévenot, L. 2006. *On justification: economies of worth*. Trans. C. Porter. New Jersey: Princeton University Press.

[27] Thevenot, L. 2001. Practice regimes governing the engagement with the world. *IN:* T.R. Schatzki, K. Knorr-Cetina, and E. von Savigny (eds). *The practice turn in contemporary theory*. Routledge :London and New York, pp56-73.

[28] Schatzki, T.R.. 2001. Introduction: practice theory IN: T.R. Schatzki, K. Knorr-Cetina, and E. von Savigny (eds). *The practice turn in contemporary theory*. Routledge : London and New York, pp1-14.

[29] Fairclough, N. 1995. *Media discourse*. London : Arnold, the Hodder Headline Group.

[30] Schatzki, T. 2005. The sites of organisations. *Organizational Studies*, 26 (3), pp465-484.

[31] Couldry, N. 2003. *Media rituals: a critical approach*. London and New York : Routledge.

[32] Gamson, W. A. and Modigliani, A. 1989. Media discourse and public opinion on nuclear power: a constructivist approach. *The American Journal of Sociology*, 95 (1), pp1-37.

[33] Schatzki, T. 2002. *The site of the social: a philosophical account of the constitution of social life and change*. Pennsylvania : Pennsylvania State University Press.

[34] Pickering, A. 2002. Cybernetics and the mangle: Ashby, Beer and Pask. *Social Studies of Science*, 32 (3), pp413-437.

[35] Latour, B. 2004. *The politics of nature: how to bring the sciences into democracy*. Trans. By Catherine Porter. Cambridge, Massachusetts : Cambridge University Press.

[36] Marcus, G.E. 1995. Introduction. *IN:* G.E. Marcus (ed.). *Technoscientific imaginaries: conversations, profiles and memoirs*. Chicago : University of Chicago Press, pp 1-10.

[37] Verran, H. 1998. Re-imagining land ownership in Australia.*Postcolonial Studies* 1(2): 237–254.

[38] Beck, U. 1992. *Risk society: towards a new modernity*. London : Sage.

[39] Beck, U. 1994. The reinvention of politics. *IN:* U. Beck, A. Giddens, and S. Lash, (eds.) *Reflexive modernisation: politics, tradition and aesthetics in the modern social order*. Cambridge, UK: Polity Press, pp1-55.

[40] Eder, K. 1996. *The social construction of nature: a sociology of ecological enlightenment.* London: Sage Publications.

[41] Habermas, J. 2003. *The future of human nature*, trans. by H. Beister, M. Pensky, and W. Rehg, Cambridge, UK : Polity Press.

[42] Lash, S. 1994. Reflexivity and its doubles. *IN:* Beck, U. Giddens, A and Lash, S. (eds.) *Reflexive modernisation: politics, tradition, and aesthetics in the modern social order*. Cambridge, UK: Polity Press, pp110-173.

[43] Latour, B. 2007. Turning around politics: a note on Gerard de Vries' paper. *Social Studies of Science*, 37 (5), pp811-820.

[44] Murphy, P. 2008. Come on, be serious: positioning and framing in the power play of classroom-based reproductive and genetic technology debates. *IN:* A. R. Bell, S. R. Davies and F. Mellor (eds.). *Science and its publics*. Newcastle: Cambridge Scholars Publishing , pp57-77.

[45] de Certeau, M. 1984. *The practice of everyday life*. Trans. by S.F. Randall. Berkeley and Los Angeles, US : University of California Press.

[46] Leach, M. Scoones, I. and Wynne, B. 2005. Introduction: science, citizenship, and globalisation. *IN:* M. Leach, I. Scoones, and B. Wynne (eds). *Science and citizens: globalisation and the challenge of engagement*. Zed Books : London and New York, pp3-14.

[47] Verran, H. 2002. A postcolonial moment in science studies: alternative firing regimes of environmental scientists and Aboriginal landowners. *Social Studies of Science* 32 (5-6): 729-62.

[48] Strathern, M. 1999. *Property, substance and effect: anthropological essays on persons and things*. London: Athlone Press.

[49] Marcus, G.E. 1998. *Ethnography through thick and thin*. Princeton, U.S. : Princeton University Press.

[50] Altheide, D.L .1987 Ethnographic content analysis. *Qualitative Sociology* 10 (1), pp65-77.

[51] Cobb, M.D. 2005. Framing effects on public opinion about nanotechnology. *Science Communication*, 27 (2), pp221-239.

[52] Gamson, W. A. 1992. *Talking politics*. Cambridge, UK/ New York : Cambridge University Press.

[53] Van Gorp, B. 2007. The constructionist approach to framing: bringing culture back in *Journal of Communication*, 15 (1), pp60-78.

[54] Mol, A. 2002. *The body multiple: ontology in medical practice*. Durham, N.C.: Duke University Press.

[55] Hine, C. 2007. Multi-sited ethnography as a middle range methodology for contemporary STS. *Science, Technology Human Values* 32, pp652-671.

[56] Hayles, K. 2002. Flesh and metal: reconfiguring the mindbody in virtual environments. *Configurations*, 10 (2), pp297–320.

[57] Munshi, D. Kurian, P. Bartlett, R.V. and Lakhtaki, A. 2007. A map of the nanoworld: sizing up the science, politics, and business of the infinitesimal. *Futures* 39, pp432-452.

[58] Drexler, K.E. 1986. *Engines of creation: the coming era of nanotechnology*. New York : Anchor Books/Doubleday

[59] Campbell, N. 2007. The technological gaze in advertising. [Online]. *Irish Marketing Review*, 19 (1,2). Available from: http://www.dit.ie/DIT/news/2008/docs/01Campbell.pdf. [Accessed 10 September 2008]

[60] Kurzweil, R. 2000. *The age of spiritual machines: when computers exceed human intelligenc*e. Sydney : Allen and Unwin.

[61] Dunwoody, S. 1994. Community structure and media risk coverage. [Online]. Paper presented to 'Technical Risk in the Mass Media' Symposium, published in *Risk: Health, Safety and Environment* 5 (3),   pp193-201. Available from   http://www.piercelaw.edu/risk/vol5/summer/dunwoody.htm. [Accessed 19 September 2008]

[62] Macoubrie, J. 2006.Nanotechnology: public concerns, reasoning and trust in government. *Public Understanding of Science* 15 (2), pp221-241.

[63] Collins, H. M. and Evans, R. 2002. The third wave of science studies: Studies of Expertise and Experience. *Social Studies of Science* 32 (2), pp. 235-296.