

Norms and Values in UK Science Engagement Practice

Eric Jensen (University of Warwick), e.jensen@warwick.ac.uk or jensen@gatesscholar.org
Richard Holliman (The Open University)

Abstract:

In recent years, there has been a rhetorical shift from 'deficit' to 'dialogue' and 'engagement' in UK policy and institutional discourse about science communication. Past efforts to reduce public scientific literacy deficits have been overshadowed by calls for dialogue between scientists, science communicators and non-scientists. However, it is unclear how this rhetorical shift has translated into a real change in the guiding principles and practices of UK science engagement. This study investigates reported practices and discourse of UK science engagement practitioners from a variety of professional backgrounds. Quantitative and qualitative data were gathered using questionnaires and focus groups. The analysis employed a theoretical lens informed by Bourdieu's theory of practice, Irwin's taxonomy of first (deficit), second (dialogue) and third (contextual) 'orders' of engagement, and theoretical conceptualizations of social change from cultural psychology and sociology. Results suggest participating practitioners' reported experience was predominately first order, although current definitions and discussions of engagement by a small number of practitioners indicate some limited acceptance of dialogue-oriented thinking. Such potential movement from past practice to current thinking is highly contingent however, not least because so few practitioners had experienced second or third order engagement. The implications of these findings are explored both in terms of understanding patterns in UK science engagement and what they portend for Bourdieu's theory of practice and social change.

Word count: 7744

The views of professionals operating in the field of science engagement are the focus of the present study. The study aims to develop insights about the ways that practitioners conceptualize this field and their science engagement practices. Drawing on Bourdieu's (1977; 1995; 2005) theory of practice, Irwin's (2008) model of 'first', 'second' and 'third' order engagement, and Jensen and Wagoner's (2009) theoretical model of social change, the present analysis explores the extent to which practitioners may have changed their norms and values to meet the challenges of science engagement.

What is science engagement?

The term 'science engagement' is used here to encompass any communication about scientific or technical topics that involves scientists, stakeholders and citizens. Within this field, well-established practices of 'science outreach' aimed at 'public understanding of science' (PUS) have involved scientists (and some technologists, engineers and mathematicians), museum workers, media professionals, science teachers and professional

science communicators 'educating' members of the public. Within the PUS framework, communication is characterized as one-way or 'first order' (Irwin, 2008); that is, from the sciences ('experts') to members of the public ('non-experts').

In the last 15 years, however, there has been much greater policy focus on promoting 'two-way' *dialogue* between the sciences and their publics. For example, in 2001 what was then called the UK Government's Office of Science and Technology, and the medical charity the Wellcome Trust (2001, p. 315), published a jointly authored paper which included the following statement, that "an 'engagement model' of science communication - a two-way dialogue between specialists and non-specialists - is more appropriate than the 'deficit model', which only gives information about science".ⁱ Since 2000, numerous declarations of this kind have been communicated to UK science engagement practitioners, including high-profile reports from the House of Lords Select Committee on Science and Technology (2000), jointly from the Royal Society and Royal Academy of Engineering (2004), and more recently from the Sciencewise Expert Resource Centre (2009; see also Stilgoe, 2009).ⁱⁱ Furthermore, the UK government recently conducted a consultation on science and society (DIUS, 2008), which informed the introduction of a number of expert working groups as part of an overall strategy. Moreover, funding has been forthcoming for a range of engagement activities, including the introduction of a National Coordinating Centre for Public Engagement (NCCPE; www.publicengagement.ac.uk). Indeed, it is clear that "public engagement has become the new mantra" (MacNaghten, Kearnes, & Wynne, 2005, p. 281).

Investigating the field of science engagement

Despite the rhetorical shift towards 'dialogue' and 'engagement' in UK science policy discourse, research evidence has questioned the degree to which science communicators have adopted the goals of this new 'engagement' agenda (e.g., Davies, 2009; Burchell, 2007; Irwin, 2006). This study addresses this topic with an exploratory assessment of the methods and definitions of current science engagement practices (Holliman & Jensen, 2009). We collected a range of quantitative and qualitative data via self-reports ($n = 59$), questionnaires ($n = 44$) and focus groups (with eight groups involving 54 participants in total) to investigate the range and scope of their experiences of, and attitudes to, science engagement. The research participants included scientists, professional science communicators, science teachers and others. The study involved two main research questions:

RQ1: With what types of engagement activities do practitioners have experience?

RQ2: Is there evidence of the adoption of second or third order representations of public engagement with science in the discourse of scientists and professional engagement practitioners?

Applying Bourdieu's theory of practice

This study applies the theory of practice developed by French sociologist Pierre Bourdieu to science engagement. Bourdieu's framework includes key concepts, such as 'field', 'doxa' and 'habitus'. First, we investigate whether and how the *field* of science engagement provides "a system of cognitive and motivating structures" (Bourdieu, 1990, p. 53), which exercises largely unseen and banal control over the field through the selective distribution of cultural,

symbolic and economic capital. The concept of *doxa* is then applied to science engagement practice – that is, the ‘common sense’ assumptions within a particular field – which can be inferred from practitioner discourse. Bourdieu (2005, pp. 36-37) defines *doxa* as the “principal practical schemes which make it possible to organize the world, but which remain implicit”. There is a general *doxa* comprising the “universe of the tacit presuppositions that we accept as the natives of a certain society” (Bourdieu, 2005, p. 37). But there are also field-specific *doxa* that encompass systems “of presuppositions inherent in membership in a field” (Bourdieu, 2005, p. 37). Uncovering this field-specific *doxa* and its role within science engagement is a major goal of this study.

Finally, individual experience also plays a central role in Bourdieu’s framework. According to Bourdieu, the impact of structures (e.g. institutional norms and mandates) on an individual is cumulative. Over time, one’s cumulative experience with the objective structures of a field yields a “generative principle of regulated improvisation” that makes smooth and effective action come naturally to an agent (Bourdieu, 1977, p. 78). This embodied phenomenon is *habitus*. This was apparent in the findings of research commissioned by the Royal Society, *et al.* (2006) where the experiences of science engagement of practitioners partly depended on the stage of their career. As a result of this study, we were particularly interested in investigating the different experiences of scientists at various career stages, and designed our sample with this in mind. However, *habitus* is not the major emphasis of the present study.

Two key aspects of Bourdieu’s theory of practice have come under sustained criticism. First, some have argued that the theory is too static, offering little detail about how existing systems undergo social change. Second, Benson (2005) points out that to apply Bourdieu’s theory to a particular field, conceptual field-specific tools are required to develop a valid understanding. To address these limitations in the present study, Bourdieu’s original theory has been augmented with a recent model of social change and field-specific theorization of science engagement.

Science engagement and social change

Bourdieu’s theory of practice is primarily focused on the reproduction of existing practices (cf. Bourdieu & Wacquant, 1992). As such, in the present study we supplement our Bourdieuan analysis with the theoretical model of social change developed by Jensen and Wagoner (2009, p. 220) who propose that social change is “continuous, long-term and cyclical,” characterized by four general phases in the development and implementation of new ideas and practices (Figure 1).

[Suggested location of Figure 1]

First, they explicate a Transcendent→Transcendent (T→T) phase for social representations such as *PUS* versus *public engagement*, where they are debated at the level of ‘pure’ ideas. In this instance, these debates centre on defining engagement, how it relates to public understanding, and the motives behind both approaches. Informed and inspired by past events and ideas (I→T), these pure ideas are labelled *transcendent representations*. When a new transcendent representation such as ‘engagement’ is forged, a number of different actors may seek to translate it into an *immanent representation* that guides thinking at the

level of practice (Harré, 1998)ⁱⁱⁱ. This phase is labelled Transcendent→Immanent (T→I). Jensen and Wagoner describe this T→I phase as follows:

“Organizations are mobilized to create norms and practices that align with the ascendant transcendent representations. If a transcendent representation is successfully encoded into professional norms and practices, then the putative social change will enter the next phase.

(Jensen & Wagoner, 2009, p. 219)^{iv}

We argue that the Transcendent→Immanent (T→I) phase may apply to the current status of practitioners working in the field of science engagement, which makes it an interesting subject for further investigation.

Investigating first, second and third order thinking

It is unclear to what degree the new transcendent representation of engagement has been adopted into immanent representations and practice in this field. In order to detect any changes, Irwin's (2008) taxonomy of 'orders of thinking' is employed in this study (Table 1).

[Suggested location of Table 1]

In summary, Irwin (2008) defines deficit-informed approaches as 'first order'. He describes as 'second order' dialogic approaches that aim for an exchange of perspectives between the sciences and publics. Finally, he introduces a new 'third order' for activities that seek to set the sciences in a wider social context, involving multiple stakeholder perspectives within the context of a reflexive, critically-informed and pluralistic set of ongoing discussions and debates.

The above taxonomy provides a useful conceptual framework for assessing the attitudes about, and practices of, science engagement. However, like Irwin (2008), the present study does not take a normative stance on whether one order of science engagement is inherently superior. Rather, all three orders are assumed to have a role within science engagement, depending on the context and motivations of the stakeholders involved. Moreover, neither Irwin's model nor Jensen and Wagoner's would assume there is an inevitable progression in any direction, for example, either favoring or disfavoring second order engagement.

This study explores whether there is evidence of the introduction of second and third order thinking as additional transcendent representations within science engagement. To this end, the frameworks developed by Bourdieu (1977), Jensen and Wagoner (2009) and Irwin (2008) were all applied to the present data.

Methods

This study adopted a mixed methods approach to data collection involving focus groups, questionnaires and self-reports from science engagement practitioners in the form of 'activity summaries' (Jensen & Holliman, 2009). Taken together the data collection strategy adopts the methodological framework of 'complementary assistance' (Morgan, 1998). Data collection for this study was conducted from May to August 2007. The study follows a primarily qualitative methodological approach to developing an exploratory empirical account of values guiding UK science engagement practice, which we have then interpreted in theoretical terms.

Theoretical sampling of the field of science engagement

Following a theoretical sampling strategy (e.g. Strauss & Corbin, 1998) we included a range of practitioners working within science engagement. To begin the process of selecting participants that represent this field, a qualitative assessment of the range of practitioners who routinely develop, deliver and evaluate science engagement activities was conducted through the examination of relevant websites, informal consultation with practitioners, and a comprehensive review of the research and practice literature (the latter including primary, secondary and, where relevant and credible, grey literature). However, we do not claim to have definitively defined the full extent of the field of science engagement as a result of this theoretical sampling strategy.

In operationalising the field of science engagement we identified academic scientists as an obvious category for further exploration. Within the category of scientists we studied postgraduate, early career (within five years of completing a PhD) and experienced scientists (more than 5 years post-PhD). (We note that only the 'early career' and 'experienced' scientists from this category represent individuals covered by the Royal Society, *et al.* (2006) study). We also sought scientists working in a wide range of disciplines. However, we note the sampling limitation that we did not include scientists working in sectors of the economy other than academia, for example from industry or from the government.

We extended the sample of scientists by including a convenience sample of 'Science Staff Tutors', who are assigned to work in each of the Open University's 13 regional centres. Their main roles are related to teaching and managing part-time Associate Lecturers (tutors) working on science courses. As such, most Open University Science Staff Tutors are not active researchers in the sciences, though they frequently have PhDs in a scientific discipline (or a significant level of scientific training), and several were once practicing bench scientists. These participants were included in the sample for three main reasons: (1) for their experience in organising science engagement events; (2) for their experience in working with professionals interested in science engagement; (3) as a small community that regularly meets to reflect on their science engagement practices. We also note that individuals without an active scientific research profile, such as these, would not have been included in the Royal Society, *et al.* (2006) study. Their inclusion therefore extends the scope of previous research into this field.

Professional science communicators are also included in the study to provide a broader view of science engagement. Professional science communicators were defined as those whose primary work responsibility was for some aspect of science communication, e.g. at a museum, media professional etc. Furthermore, science teachers were included within the overall sample as this category of staff routinely engages with other practitioners to run science engagement events. Finally, 'pro-ams' (amateurs with specialized scientific expertise) were also sampled, that is, those with a particular interest in some area of scientific endeavour, but who do not seek to gain formal qualifications in relation to that interest (Leadbetter and Miller, 2004). Pro-am scientists might include amateur ornithologists, astronomers, fossil hunters, etc.

Recruiting research participants

Contact letters were distributed electronically to science departments at five UK universities, numerous science organizations and pro-am science groups, a listserv for professional science communicators, and other venues. These letters solicited participants with experience or practitioner knowledge of science outreach, science communication or public engagement with the sciences. Recipients were asked for contact information and to 'self-report' their science engagement experiences in a 1-2 paragraph summary.

The recruitment method for the activity summaries yielded 59 respondents (Table 2). These summaries varied in length from a few sentence fragments to two or three fully formed paragraphs. These descriptions of past practitioner experience offered a useful starting point for investigating science engagement.

[Suggested location of Table 2]

Preliminary questionnaire

The participants who submitted these 'activity summaries' were asked if they would be willing to participate in a focus group study. If they said yes, they were asked to complete the preliminary questionnaire in advance of the focus group. In total, 44 participants completed this preliminary questionnaire (Table 2), which asked about basic demographic information, experiences of science engagement, reasons for participating in these activities, and any challenges they had previously faced. Furthermore, the analysis of this questionnaire data informed the semi-structured question guide used by moderators during the latter stages of the focus groups.

The sample for the initial questionnaire ($n = 44$) differed from the focus group sample ($n = 54$) in two respects. The staff tutor focus groups were organized through a gatekeeper^v, and ultimately only five of the total staff tutor participants ($n = 22$) completed the initial questionnaire prior to the focus group interviews. Secondly, we note that seven of those who completed this initial questionnaire, but were not staff tutors, were unable to attend the subsequent focus group. Thus, three overlapping but distinct samples and forms of data emerged: activity summaries ($n = 59$), completed questionnaires ($n = 44$) and focus group participants ($n = 54$) (Table 2). Thirty-one participants completed all three forms of data collection. These data were analysed to address the above research questions.

Sampling for the focus groups

The distribution of participants in the eight focus groups can be seen in Table 3, alongside the gender distribution, date of the focus group, its location, and the product of the focused activity (see below for discussion of the latter).

[Suggested location of Table 3]

The distribution of participants matched the categorisations for the theoretical sampling as closely as possible. We note, however, that despite numerous attempts to do so we were unable to recruit a group of 'pro-ams'. Group 8 therefore became a 'mixed' group of science

engagement practitioners, including two professional science communicators, a pro-am interested in geology, and a science teacher.

Focus group structure

Each focus group lasted for approximately 3 hours and followed a similar structure, involving six stages. The groups began with an initial briefing (Stage 1), followed by a focused activity (Holliman, 2005) involving the preparation and presentation of a science engagement activity (Stages 2 and 3). In Stage 2 groups were asked to develop an engagement activity plan, and then describe their reasoning for this plan. To begin this stage the moderator distributed an information sheet to each participant and then placed a stack of laminated cards in the middle of the table. On these cards were a number of activities, representing first-, second- and third-order approaches: e.g. lecture demonstration, podcast, Megalab, citizen's jury, café scientifique (Grand, 2009; www.cafescientifique.org), deliberative meeting of citizens (DEMOCS; www.neweconomics.org/gen/democs.aspx), and so on. The participants were asked to discuss what they knew about each of these options amongst themselves, and decide on one activity to work with. Next, they were asked to construct a storyboard detailing how they would prepare and conduct their selected activity, including a reflection on and/or evaluation of the activity.

Participants presented their storyboards in Stage 3, leading to a general discussion in Stage 4 based on a semi-structured question guide. Stage 4 began with further probing about Stages 2 and 3 (based on moderator observations), asking participants to articulate the reasons for selecting the particular activity and any difficulties that could be identified in developing and running it. The questions also invited discussion about the reasons for participating in science engagement, some of the challenges in participating, and so on, drawing on some of the questions posed as part of the Royal Society, *et al.* (2006) study. In Stages 5 and 6 participants completed a final questionnaire and were debriefed.

Data analysis

The text-based data from the activity summaries and questionnaires were collated for analysis. Each focus group was recorded digitally and fully transcribed for analysis. The storyboards were analysed through the same theoretical lens as the text-based data. Data from the activity summaries, questionnaires and focus group transcripts were coded following a 'grounded' discourse analysis approach (e.g. Jensen, 2008; Strauss & Corbin, 1998) to inductively identify basic patterns of meaning in the data. These patterns guided selection of appropriate theoretical frameworks (as discussed in the introduction), which were then deductively applied to the coded data. This approach aimed to develop an integrated account that was both data driven and theoretically informed. Bourdieu's (1977) theory of practice and Jensen and Wagoner's (2009) theory of social change provided the theoretical frameworks for the deductive phase of the analysis. In addition, Irwin's (2008) taxonomy of orders of engagement offered a field-specific framework for further refining the analysis (Table 1).

Results

To address the research questions, data from activities summaries, questionnaires, and focus groups were analysed. A random sub-sample of the data was then re-analysed by a second coder for each framework, yielding inter-rater reliability of 100%.

Previous experiences of science engagement: Analysing the activity summaries

The results from the analysis of the activity summaries are presented in Table 4, examining past science engagement experience.

[Suggested location for Table 4]

This analysis suggests that most reported prior experience was first order, i.e. deficit informed, with 94% of the experiences coded in this category (the other 6% had no prior science engagement experience). This categorisation was consistent across all types of participants. Indeed, all respondents providing relevant data had experience with first order activities. The following extract is an example of such reported first order experience:

I think it is extremely important to enthuse future generations about many of the fascinating branches of science. This is partly because it's simply fun and interesting, but more importantly is crucial for industry. I am currently involved in a great deal of tutoring, mostly aimed at getting kids excited about the interesting things you can learn about in science.

Postgraduate Scientist – Activity Summary

In addition to their first order experiences, 4% of activity summary respondents (n = 2) reported past experience that also involved 'debate', 'dialogue', 'discussions' or 'public consultations' that could be construed as evidence of second order thinking.

"I have been involved in a number of different outreach events including regular sessions such as: ...Science and Society *Discussion* groups based around the biological sciences."

Professional Science Communicator – Activity Summary (emphasis added)

This extract indicates evidence of routine participation as part of a 'discussion' group, which we have coded as evidence of second order practices. However, we also note the use of the term 'outreach' by the same participant when describing this discussion group, which is normally, defined under first order practices. This illustrates the use of mixed terminology by this practitioner, conflating first and second order practices under a single term, in this instance 'outreach'. This pattern was also demonstrated in other participants' responses, but in these instances, first and second order activities were conflated under 'engagement'. (We also note that others (e.g. Davies, 2009) have identified practitioners using a mixture of first and second order terminology when framing science engagement activities.)

The disproportionate level of first order experiences in the activity summary data suggests that in the past, practitioners were oriented towards deficit-informed practices as part of the "practical sense" or "a proleptic adjustment to the demands" of the field of science engagement (Bourdieu, 1990, p. 66). However, past experience (*habitus*) does not definitively establish practitioners' adherence to first order thinking, nor does it preclude

the possibility of changes in the transcendent representations of science engagement practitioners. Indeed, it is possible that science engagement practitioners may change their transcendent representations of 'engagement' to include second or third order thinking, even if their accumulated experience still skews towards first order activities. As such, representations of science engagement are examined in the questionnaire and focus groups to assess whether a process of social change may be underway.

Changing ideas / practices? Questionnaire and focus group results

Although external influences are important, the boundaries of a given field, in this instance science engagement, are ultimately defined by the practitioners of that field. As Bourdieu (1986, p. 471) notes, "the social order is progressively inscribed on people's minds". That is, a "practical anticipation" of the "objective limits" of the field can be identified in practitioner discourse (Bourdieu, 1986, p. 471). Thus, the practices of science engagement are inextricably enmeshed with practitioners' self-definitions of what they do (and what they will not do), why, how, when and with what purposes they practice, any motivations and constraints, the idealised audience members (Holliman and Jensen, 2009), and so on. Whether conscious or not, the ways that practitioners conceptualize the field of science engagement at a transcendent level therefore has profound implications for their practices (i.e. immanent representations), and their practices inform how they conceptualize science engagement. Below, both questionnaire and focus group results are used to assess the degree to which emerging second or third order transcendent representations of engagement have been adopted within practitioners' discourse.

First, questionnaire respondents (see Table 2 for sample distribution) were asked to define 'science outreach' and 'public engagement', respectively, in their own words. Where the data were relevant and clear enough to code, respondents' definitions of 'science outreach' and 'public engagement' were coded as either first (deficit), second (dialogic) or third (contextual) order, following Irwin's (2008; Table 1) characterisations.

[Suggested position of Table 5]

All of the codable responses defining 'science outreach' identified it with first order thinking and activities commensurate with a 'public understanding of science' approach. The following questionnaire extract is an example of a first order definition:

"Science outreach - trying to *disseminate* scientific issues outside the scientific community to all members of the public...*Knowledge giving.*"

Experienced Scientist – Questionnaire (emphasis added)

The following focus group extract refers to a schools-based experience *delivering* scientific information to a group of school students, which can be similarly categorized as 'first order':

"I took some of my rock samples in, and I just plonked some coral, oil and coal on the desk. And...it was actually raising [the schoolchildren's] awareness of things: What have these things got in common, and where do these come from? How long do you think it takes to form them, and what you think these numbers mean?"

Focus group 5 – Open University Science Staff Tutor

The first order aims of increasing scientific knowledge are evident in the questions raised in the above extract. This is matched by the principle aim of this activity – “raising awareness” among schoolchildren about the rock samples. Such descriptions of science outreach elicited from the present study are consistent with scientists’ perceptions of the earlier transcendent representations of first order ‘public understanding of science’ (PUS) and ‘scientific literacy’ (e.g., see Irwin, 2008). They have also been identified in previous studies. For example, a Wellcome Trust/MORI (2001, p. 8) study of UK scientists asked, “What does the term ‘Public Understanding of Science’ mean to you?”. Fifty percent of respondents defined scientific literacy in terms of a non-scientist’s knowledge of the sciences. For example, one scientist defined PUS as meaning, “The layman’s level of knowledge about technical and scientific issues” (MORI, 2001, p. 9).

A further 18% of scientist respondents in the Wellcome Trust/MORI (2001) study described PUS as involving ‘informing’, ‘explaining’ and ‘educating’; one respondent described PUS as “informing the public in a way that they can understand about what we are doing” (MORI, 2001, p. 9). In these respects, the respondents’ definitions of science outreach identified in this study are commensurate with the Wellcome Trust/MORI (2001) findings. Roughly equal numbers of our respondents provided first and second / third order definitions of the more recent and currently ascendant representation of public engagement.

We also found evidence that the transcendent representation of public engagement has been adopted by some science engagement practitioners. Twelve questionnaire respondents defined public engagement as involving second and third order activities, suggesting that this representation may be in the process of being adopted in principle, at least. The following extract exemplifies a second order transcendent representation of science engagement.

“Public engagement’ is concerned with encouraging members of the public to *contribute their opinions, expertise, etc.* in a science-related context *and taking these contributions into account.*”

Experienced Scientist – Questionnaire (our emphasis)

In the first part of the extract above this experienced scientist emphasizes a second order transcendent representation of public engagement, valuing the “contributions”, “opinions” and “expertise” of “members of the public”. It could be argued that this definition partly extends to include elements of third order thinking with the requirement to take “these contributions into account”, implying that citizens have a right to be involved in the decision-making.

Conflating first order practices under the concept of public engagement

We identified some resistance to second or third order transcendent representations of ‘public engagement’. Almost half of the respondents who were able to offer a definition of public engagement (n = 13) defined it in first order terms:

“Public engagement [is based] on *creating an appreciation* for the work of science and a *general awareness of the benefits* of science.”

Professional Science Communicator – Questionnaire (our emphasis)

This extract illustrates how first order definitions, rather than second order or third order perspectives, are being conflated by some practitioners under the brand of ‘engagement’. Indeed, the extract above emphasizes the aims of public engagement as “creating an

appreciation” and a “general awareness of the benefits of science”. Similarly, the extract below defines public engagement in terms of raising public ‘excitement’ about science. In effect, both examples focus promoting science.

“You need to do [public engagement] so that both the parents and children become excited about science and engineering.”

Experienced Scientist – Questionnaire

The above extracts represent a tendency for some science engagement practitioners to reject second / third order transcendent representations, in favor of first order thinking. Indeed, the persistence of first order thinking in some practitioners’ definitions of public engagement suggests that long practical experience (*habitus*) with first order thinking may hold continuing influence on the common sense assumptions (*doxa*) of some members of the field of science engagement. For these practitioners, their “feel for the game” (Bourdieu, 1990, p. 66) continually pulls them towards first order practices.

Uncertain adoption of engagement in current thinking

In addition to first, second and third order definitions of public engagement, further evidence that the field of science engagement is currently in a transitional phase includes the fact that the largest response category to this question was the inability to provide a suitable definition of public engagement. For example:

“Other than the specific inclusion of ‘science’ in the [term] ‘science outreach’, [I] don’t know [the] difference between ‘outreach’ and ‘engagement’.”

Experienced Scientist – Questionnaire

Focus group data also indicated a pattern of uncertainty regarding representations of public engagement. In the following extract, a participant begins, querying his fellow participants about their understanding of public engagement while the moderator is out of the room.

- 2^{vi} Did you guys fill in th[e pre-focus group] questionnaire?
1 Mmh-hm.
2 Yeah? Did you know the difference between ‘outreach’ and whatever the other one was?
1 Public engagement
2 Yeah
1 I thought outreach was a bit more structured -
2 Right

Focus group 3 - Early Career Scientists

As the extract continues another focus group participant began to offer a definition of public engagement, but found he was unable to articulate it.

- 3 You know, there’s an event, you want to do something with, with an outreach being a specific-
2 Okay
3 I don’t know
2 I didn’t go and look it up. I don’t know. So, I’ll be honest and say I don’t know
3 Well, that’s what I kind of-
2 I guess we’ll find out today.

Focus group 3 - Early Career Scientists

The uncertainty visible in the above extract suggests that immanent representations of first order thinking may have been partially disembedded, while the new transcendent representation of public engagement has yet to be fully adopted. In this context, the cycle of social change could continue towards adoption of the new transcendent representation of public engagement at the immanent level, or it could just as easily shift directions.

The focused activity: reviewing the options

The uncertainty regarding transcendent representations of public engagement in some questionnaire responses was also evident in Stage 2 of the focus groups. In particular, some participants struggled to define the second and third order activities listed on the cards. As a direct consequence, these unfamiliar engagement methods were rejected by participants. The following extracts illustrate this pattern:

- 1 'Citizen jury': does anyone know what that means?
2 Uh, no.
1 Okay, well that's out then.
[...]
3 Consensus conference?
2 I don't know what that means either.
1 Anyone else? No.

Focus group 2 - Experienced Scientists

This pattern of lacking immanent representations of second/third order engagement was explicitly confirmed during follow-up questioning later in the focus group session:

- M Why did you select that particular activity about a [first order] school visit as opposed to these other ones here?
[The moderator points to the cards listing second/third order activities.]
2 A lot of the other ones [engagement methods] we discounted because we didn't know what they were; that was quite easy.

Focus group 2 - Experienced Scientists

Thus, focus group participants tended to select activities with which they were already familiar at the immanent level:

- 1 We deliberately picked something that we knew most about anyway, so that probably made [planning] slightly easier. If we'd picked something none of us had ever heard of then we'd have struggled.

Focus group 1 - Postgraduate Scientists

The group decision-making process during the early stages of the focused activity offers insights into the prior knowledge and experience (habitus) of these practitioners. The process of selecting a single activity from the range of available options followed a discernible pattern across all focus groups. First, a lack of knowledge about most of the available options immediately narrowed the range of activities under consideration. Second,

each group's orientation towards first, second or third order approaches was decisive in the selection from within this narrowed field of options.

The general discussion

Discussion in the groups focused on a number of relevant issues, not least the reasons for conducting science engagement activities. Participant responses to these questions illustrated first order thinking, seeking to stimulate interest by providing 'positive' images of science and scientists that challenged 'negative' stereotypes. Similarly, a further common aim was to increase levels of scientific knowledge, in part by challenging (perceived) misconceptions about the sciences. In this respect, the emphasis was on first order science engagement through the communication of 'scientific facts' with the secondary public relations aim of providing 'positive' images of science and scientists, particularly for children and young people.

These purposes were often implicitly linked to discussions about what was considered to be 'acceptable' content for science engagement. Such discussion is revelatory of practitioners' immanent representations of science engagement. Several of the groups discussed how to deal with discussion of controversial issues, for example. Two of the groups argued for *de facto* self-censorship of: consideration of religious explanations in relation to scientific explanations (Professional Science Communicators; Focus group 7); and the use of animals in scientific research (Mixed group; Focus group 8). In this respect, these groups were comfortable with using activities for the purposes of 'boundary work' (Gieryn, 1999; 1995): in effect, to (re)construct what they defined as '(un)scientific'. This approach is indicative of first order immanent representations of science engagement, by assuming that scientific experts should set the agenda and define the terms and conditions under which topics are discussed.

Discussion of what should be considered a suitable topic for science engagement also demonstrated that some participants were keen to avoid what were considered to be complex and controversial science-based issues, instead communicating science as 'objective fact'.

The first order characterisation of scientists communicating as a 'duty' or 'obligation' was mentioned in both the focus group discussions and questionnaire responses, in part as justification for the use of public funding for scientific investigations. Similarly, they identified idealised audiences, mainly children and young people who had yet to decide on a career path. It follows that the location and context of these idealised activities was related to one of the core objectives discussed by these participants—to recruit future generations of scientists, technologists, engineers and mathematicians.

With the school context in mind, participants drew on their (often considerable) experiences as scientists conducting activities in schools, but also as parents of children who might be asked to participate in schools-based activities. In general, these participants favored activity-based events, for example, getting children to participate in first order, hands-on experiments, rather than first order lecture-based formats, or second order dialogic forums. The reasoning behind these selections was to make first order science engagement more effective by enhancing its 'interactivity'.

However, this finding should be seen in contrast to the discourse of other participants who either chose complex science based issues as the basis of their activity (early career

scientists and the issue of carbon footprints), or second order formats that promote dialogue, such as the selection of a café scientifique by two of the focus groups. In these respects the focus group discussions suggest that science engagement is indeed in a transitional phase, although the transcendent representation of public engagement has yet to be fully embedded as an immanent representation. Our data suggest that this transitional phase is characterized by divergent common sense understandings of the field of science engagement.

This divergence can be further explored from a theoretical perspective. Specifically, Bourdieu's theory of practice indicates that there is only one doxa per field, and that a field can be defined by its struggle for the same resources (whether financial, symbolic or cultural capital). However, our data challenge this precept of Bourdieu's theory, at least in the context of a new and changing field such as the science engagement field. The co-existence of contradictory definitions of public engagement in this field suggests that there can be more than one doxa at times of readjustment in a field. At the same time, science engagement, and science more broadly, are clearly heterogeneous fields with multiple sub-fields (each with different resource valuations). The existence of such hybridized fields, which nevertheless compete for some of the same resources, represents a challenge to Bourdieu's original theory of practice. This raises the idea of a 'hybrid' or 'hybridized' doxa within a changing and partially hybridized field of practice.

Some in the field have already accepted a new common sense notion, or hybridized ideal of public engagement, which includes at least second order practices. Other practitioners have implicitly resisted this shift. However, the extent of this doxic hybridity is not fully visible to practitioners themselves due to their divergent implicit definitions of the ascendant term *public engagement*. This divergence can be seen in the even split between questionnaire respondents defining public engagement in first order or in second/third order terms.

Discussion

Using a combination of research methods with the aim of achieving complementary assistance (Morgan, 1998), we have studied practitioners within the field (Bourdieu, 1990) of science engagement, evaluating whether they are adopting second/third order transcendent and immanent representations of public engagement (Jensen & Wagoner, 2009). We have assessed the orders of thinking (Irwin, 2008) represented in practitioners' discourse about science engagement through systematic investigation of activity summaries, questionnaire data, and focus group transcripts and the process of planning science engagement activities. This analysis revealed a mostly constricted set of science engagement methods in the past experience of our participants. Indeed, these data imply that immanent representations reflect first order values (also see Jensen & Buckley, 2014), as characterized by Irwin (2008). However, current discourse about public engagement amongst practitioners was found to be much more heterogeneous, drawing on some second order transcendent representations. Likewise, the focus group discussions and engagement planning evinced a mix of first and second order representations of engagement, suggesting that this field of practice is in an on-going state of flux.

This article began by identifying a recent diffusion of the concept of second order (dialogic) public 'engagement' with science and technology within UK science policy (Irwin, 2006). In essence, the UK Government has expressed the desire to avoid "public scepticism brought

about through poor engagement and dialogue on [scientific] issues of concern” (*Science and innovation investment framework 2004-2014*, 2004, p. 105), a perspective that has been supported by a number of high-profile scientific institutions and funding bodies. To this end, projects and initiatives have been instigated to support and embed the transcendent representation of dialogic public engagement into an immanent representation that guides practical decision-making about science engagement. The present study suggests this second order representation of engagement has been at least partially adopted by our sample, but primarily at the transcendent level.

This finding is evident in our respondents’ discourse, with a significant minority defining public engagement in terms that were at least second order, with others expressing uncertainty or confusion (also see Holliman & Jensen, 2009). At the same time, the study raises the concern that some practitioners may not have the time, resources and support needed to enact a more dialogic representation of science engagement at the immanent level. This suggests a possible policy problem, with demands for greater science engagement not being accompanied by concomitant resources.

Sustained economic and symbolic capital from the UK Government and scientific institutions is important in supporting the expansion of science engagement methods to include second and third order approaches. Similarly, practitioners need routine, institutionalized reinforcement in terms of resources, workload allocations, supportive promotion criteria and training opportunities if a change in science engagement norms is to take root. Indeed the focus group discussions indicated that further training, resources and institutionally organized activities were desired by practitioners to provide the skills, confidence and opportunities to expand their repertoires of engagement methods.

Large-scale studies of the field of science engagement like that conducted by the Wellcome Trust/MORI (2001) in 1999 showed no evidence of second or third order transcendent representations. Therefore, finding even a minority of practitioners in this exploratory study defining public engagement in second order (dialogic) terms may suggest that this is a field that is changing or at least hybridising its self-conceptualisation. Of course, this possibility can only be posited as a preliminary hypothesis, given the small-scale nature of the present research.

Drawing on Jensen and Wagoner’s (2009) cyclical model of social change, we would argue that the current state of the field is well into the T→I phase; this phase involves translating the new second order transcendent representations into second order immanent representations guiding practice. In other words, the question at this stage is whether the new “transcendent representation is successfully encoded into professional norms and practices” (Jensen & Wagoner, 2009, p. 219). Insofar as this encoding takes effect, the next major phase for public engagement will be determined by the degree to which second order approaches produce positive outcomes within the science engagement field of practice. The promise of second order science engagement must confront practical realities: The continued ascendance of this dialogic ideal will depend on the outcome of this confrontation.

References

- Beck, U. (1992). *Risk society: Towards a new modernity*. London: Sage.
- Beck, U. (1994). The reinvention of politics: Towards a theory of reflexive modernization. In U. Beck, A. Giddens & S. Lash (Eds.), *Reflexive modernization: Politics, tradition and aesthetics in the modern social order*. Cambridge: Polity Press.
- Benson, R. (2005). Mapping field variation: Journalism in France and the United States. In R. Benson & E. Neveu (Eds.), *Bourdieu and the Journalistic Field*. (pp. 85-112). Cambridge: Polity Press.
- Bourdieu, P. (1977). *Outline of a theory of practice* (R. Nice, Trans.). Cambridge: Cambridge University Press.
- Bourdieu, P. (1986). *Distinction: A social critique of the judgement of taste* (R. Nice, Trans.). London: Routledge.
- Bourdieu, P. (1990). *The logic of practice* (R. Nice, Trans.). Cambridge: Polity Press.
- Bourdieu, P. (2005). The political field, the social science field, and the journalistic field. In R. Benson & E. Neveu (Eds.), *Bourdieu and the journalistic field* (pp. 29-47). Cambridge: Polity.
- Bourdieu, P., & Wacquant, L. (1992). *An invitation to reflexive sociology*. Cambridge: Polity.
- Davies, S. (2009). Learning to engage; engaging to learn: the purposes of informal science-public dialogue. In R. Holliman, E. Whitelegg, E. Scanlon, S. Smidt & J. Thomas (Eds.) *Investigating science communication in the information age* (pp. 72-85). Oxford: Oxford University Press.
- Giddens, A. (1991). *Modernity and self-identity: Self and society in the late modern age*. Cambridge: Polity Press.
- Harré, R. (1998). The epistemology of social representations. In U. Flick (Ed.), *The psychology of the social*. Cambridge: Cambridge University Press.
- Holliman, R., & Jensen, E. (2009). (In)authentic science and (im)partial publics: (Re)constructing the science outreach and public engagement agenda. In R. Holliman, L. Whitelegg, E. Scanlon, S. Smidt & J. Thomas (Eds.), *Investigating science communication in the information age: Implications for public engagement and popular media* (pp. 35-52). Oxford: Oxford University Press.
- Irwin, A. (2006). The Politics of Talk: Coming to Terms with the 'New' Scientific Governance. *Social Studies of Science*, 36(2), 299 - 320.

- Irwin, A. (2008). Risk, science and public communication: third order thinking about scientific culture. In M. Bucchi & B. Trench (Eds.), *Public Communication of Science and Technology Handbook* (pp. 199-212). London: Routledge.
- Irwin, A. (2009). Moving forwards or in circles? Science communication and scientific governance in an age of innovation. In R. Holliman, L. Whitelegg, E. Scanlon, S. Smidt & J. Thomas (Eds.), *Investigating science communication in the information age: Implications for public engagement and popular media*. Oxford: Oxford University Press.
- Jensen, E. (2008). The Dao of human cloning: Hope, fear and hype in the UK press and popular films. *Public Understanding of Science*, 17(2), 123-143.
- Jensen, E. & Buckley, N. (2014). Why people attend science festivals: Interests, motivations and self-reported benefits of public engagement with research. *Public Understanding of Science*, 23.
- Jensen, E. (2012). Scientific controversies and the struggle for symbolic power. In B. Wagoner, E. Jensen & J. Oldmeadow (Eds.), *Culture and Social Change: Transforming society through the power of ideas*. London: Information Age.
- Jensen, E., & Holliman, R. (2009). Investigating science communication to inform science outreach and public engagement. In R. Holliman, L. Whitelegg, E. Scanlon, S. Smidt & J. Thomas (Eds.), *Investigating science communication in the information age: Implications for public engagement and popular media* (pp. 55-71). Oxford: Oxford University Press.
- Jensen, E., & Wagoner, B. (2009). A cyclical model of social change. *Culture & Psychology*, 15(2), 217-228.
- MacNaghten, P., Kearnes, M. B., & Wynne, B. (2005). Nanotechnology, governance, and public deliberation: What role for the social sciences? *Science Communication*, 27(2), 268-291.
- Morgan, D. L. (1998). Practical strategies for combining qualitative and quantitative methods: Applications to health research. *Qualitative Health Research*, 8(3), 362-376.
- MORI. (2001). *The role of scientists in public debate: Full report*. London: The Wellcome Trust.
- Rogers-Hayden, J. W. T., Mohr, A., & O'Riordan, T. (2005). Seeking Citizens' Views on GM Crops: Experiences from the United Kingdom, Australia. and New Zealand. *Environment: Science and Policy for Sustainable Development*, 47(7), 22 - 37.

Science and innovation investment framework 2004-2014. (2004).). London: HM Treasury/Department of Trade and Industry/Department of Education and Skills.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory.* Thousand Oaks, CA: Sage Publications.

Wagoner, B., Jensen, E. and Oldmeadow, J. (Eds.), *Culture and Social Change: Transforming society through the power of ideas.* (2012, Information Age Publishers).

Figure 1:

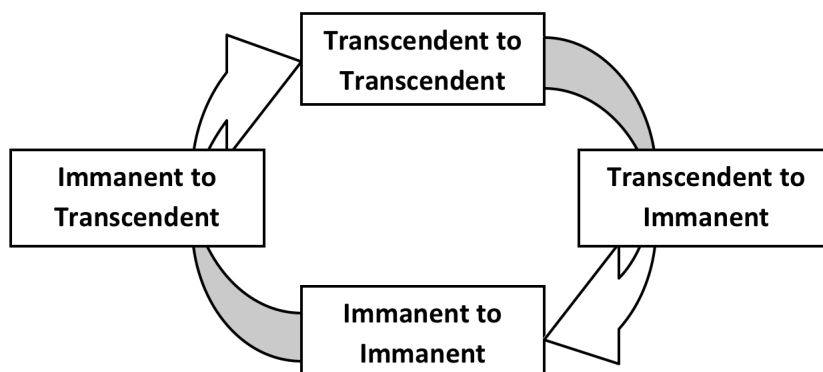


Table 1: Irwin’s orders of public engagement taxonomy

	First Order	Second Order	Third Order
<i>Main focus</i>	Public ignorance and technical education	Dialogue, engagement, transparency, building trust	The direction, quality and need for socio-technical change
<i>Key issues</i>	Communicating science, informing debate, getting the facts straight	Re-establishing public confidence, building consensus, encouraging debate, addressing uncertainty	Setting science and technology in wider cultural context, enhancing reflexivity and critical analysis
<i>Communication style</i>	One-way, top-down	Two-way, bottom-up	Multiple stakeholders, multiple frameworks
<i>Model of Scientific Governance</i>	Science-led, 'science' and 'politics' to be kept apart	Transparent, responsive to public opinion, accountable	Open to contested problem definitions, beyond government alone, addressing societal concerns and priorities
<i>Socio-technical challenge</i>	Maintaining rationality, encouraging scientific progress and expert independence	Establishing broad societal consensus	Viewing heterogeneity, conditionality and disagreement as a societal resource
<i>Overall perspective</i>	Focusing on science	Focusing on communication and engagement	Focusing on scientific/political cultures

Table 2: Sample Distribution

Description of participants	Activities summary	Initial questionnaire	Participation in focus group
Postgraduate research students	10	8	7
Early career scientists	9	7	4
Experienced scientists	9	6	5
OU Science Staff Tutors	-	5	22
Science Teachers	7	6	7
Professional Science Communicators	23	11	8
'Pro-am'	1	1	1
Total	59	44	54

Table 3: Sample for preliminary focus group study

Group ID	Description of participants
Group 1	Postgraduate research students
Group 2	Experienced scientists
Group 3	Early career scientists
Group 4	Open University Science Staff Tutors
Group 5	Open University Science Staff Tutors
Group 6	Science Teachers
Group 7	Professional Science Communicators
Group 8	'Mixed' Group

Table 4: Past Science Engagement Experience ($n = 81$)^{vii}

	1 st Order	2 nd Order	3 rd Order	Order Unclear
Scientists ^{viii} ($n = 28$)	27 (96)	-	-	1 (4)
OU Science Staff Tutors ^{ix} ($n = 22$)	20 (91)	-	-	2 (9)
Professional Science Comm. ^x ($n = 23$)	21 (91)	3 (13)	-	2 (9)
Science Teachers ($n = 7$)	7 (100)	-	-	-
Pro-am ($n = 1$)	1	-	-	-
Total (% of total n)	76 (94)	3 (4)	(0)	5 (6)

Table 5: Defining 'Science Outreach' and 'Public Engagement' ($n = 44$)

Type of definition	'Outreach'	'Public engagement'
1 st Order	28	13
2 nd /3 rd Order	0	12
No response or N/A	16	19

Endnotes

ⁱ We note that an emphasis on ‘two-way’ dialogue has the unfortunate effect of reinforcing the idea that ‘science’ and ‘the public’ are homogenized entities, as the only stakeholders who need to engage in debate. We dispute this idea, arguing instead, as Irwin (2008), Irwin and Wynne (1996) and others have, that effective dialogue and deliberation will almost inevitably involve ‘third order thinking’ with multiple stakeholders, arguing from a range of positions, and drawing on various forms of knowledge and expertise to support their arguments.

ⁱⁱ We note, following Irwin (2008), that the shift from ‘deficit’ to ‘dialogue’ did not involve a simplistic change of practices around the turn of the millennium. The democratisation of science policy had been advocated far earlier than this. Neither has this call for a shift in practices been complete or indeed universally welcomed.

ⁱⁱⁱ Harré (1998) develops the distinction between transcendent and immanent social representations: “a representation may be transcendent to a practice, that is, exist independently of the practice to which it is relevant”, while immanent social representations have “no existence independent of the practice to which it is relevant” (p. 130).

^{iv} The next phase in Jensen and Wagoner’s (2009) model is Immanent→Immanent (I→I), wherein new practices confront social reality with positive, negative or neutral outcomes. If outcomes are negative, then there may be a practice-informed reconsideration of the original transcendent representation in an Immanent→Transcendent (I→T) phase, which could ultimately develop into a new T→T phase debate (for further detail, see Wagoner, Jensen & Oldmeadow, 2012).

^v The intermediate role of this gatekeeper prevented the project team from being able to contact participants directly to request their completion of the questionnaire, or to send reminders.

^{vi} These numbers represent different participants within the groups. ‘M’ stands for moderator.

^{vii} An individual practitioner could have their activities coded into multiple categories (e.g. ‘1st Order’ and ‘2nd Order’).

^{viii} This category includes postgraduate, early career and experienced scientists. It is notable that only the ‘Early Career’ and ‘Experienced’ scientists from this category represent individuals covered by the Royal Society study of practicing bench scientists’ science outreach practices.

^{ix} As with the ‘inactive’ scientists, most Open University Science Staff Tutors are now in largely teaching and administrative roles, though they frequently have PhDs in a scientific discipline, and many were once practicing bench scientists. Those individuals without an active scientific research profile would not have been included in the Royal Society study.

^x While the Scientists category included professional bench scientists currently conducting research and teaching, professional science communicators come from a range of different scientific and educational experience. One sub-group is comprised of former or ‘inactive’ scientists – that is individuals usually with a PhD in a scientific discipline- who were previously practicing bench scientists but now operate in a variety of other roles. Such individuals were not included in the Royal Society study.