

Factors affecting public engagement by researchers

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Key findings of the literature review

The objective of this report is to present a review of the literature since 1985 on the 'factors affecting public engagement by researchers', with particular emphasis on the views and attitudes of researchers themselves. The review accompanies new empirical research on this topic¹, and is funded by a Consortium of 15 UK funders of public research². The literature in the review was identified via purposive searches of specific journals and institutional websites, and ongoing discussions with stakeholders. Although the review draws on an international literature, these Key findings specifically relate to the UK.

1. **The literature** is diverse in terms of the disciplinary populations and the frames of public engagement that it employs (two-way engagement, science communication, outreach etc.). The implication of this is that the literature presents a somewhat unclear and confused picture.
2. **Gaps:** five broad issues are relatively under-researched in the literature: the arts, humanities and social science disciplines (especially prior to 2008); the more dialogic elements of public engagement; public engagement as part of the 'impact' and 'responsible research and innovation' agendas; the views of public engagement 'enablers' and Vice-Chancellors; and rigorous longitudinal research.
3. **The 2015** 'Factors affecting public engagement by researchers' primary research addresses most of these items and is also an opportunity to establish a baseline for a valuable body of longitudinal research.
4. **The histories** of the activities that now constitute public engagement are markedly different across disciplines. The distinction between the STEM (science, technology, engineering and mathematics) and other disciplines is particularly notable. This appears to shape contemporary understandings of – and participation in – public engagement among researchers.
5. **Researchers' understandings** of what constitutes public engagement are wide and varied. Although the more interactive objectives of public engagement are increasingly reflected in researchers' understandings, objectives relating to one-way communication and education remain prevalent in some contexts.

1 Available at: www.wellcome.ac.uk/PERSurvey

2 The Consortium comprises: Wellcome Trust, Royal Society, British Academy, Royal Academy of Engineering, Academy of Medical Sciences, Royal Society of Chemistry, United Kingdom Research Councils, Higher Education Funding Council for England, Higher Education Funding Council for Wales, Scottish Funding Council, Department for Employment and Learning – Northern Ireland, Department of Health (NIHR), the Scottish Government, Department for Business, Innovation and Skills and the Welsh Government (National Institute for Social Care and Health Research). The research is also supported by Universities UK.

6. To emphasise the **two-way nature** of public engagement, media work is not included in the definition that is offered in the Concordat for Engaging the Public with Research (Research Councils UK et al., 2010), nor that employed in the 2015 research. However, media work remains an important element in many researchers' understandings.
7. **Extent:** the extent of researcher participation in public engagement appears to have been stable in recent years. Public engagement inevitably struggles to compete for time and resources in a research-driven profession. The extent of participation in public engagement among women may be slightly higher than among men. Participation in public engagement is considerably higher in the arts, humanities and social sciences than in the STEM disciplines.
8. **Training** in public engagement is valued by researchers and is associated with greater confidence and levels of participation. There is evidence that there is slightly greater participation in and desire for training among female researchers, and among researchers in the arts, humanities and social sciences.
9. **Systems of reward and recognition** tend to be supported by researchers (with some caveats) and appear to support participation. Researchers in the arts and humanities appear to feel that their public engagement efforts are rewarded to a considerably greater extent than researchers in other disciplines.
10. **The Beacons for Public Engagement projects** suggest that – when institutional time and resources are directed towards public engagement – institutional change does take place. Since these projects were evaluated in different ways, it is not easy to understand the dynamics of this change. More broadly, systematic evaluation of public engagement by researchers and institutions remains the exception rather than the rule.

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1 Introduction

Research into ‘Factors affecting public engagement by researchers’

This literature review has been produced to accompany quantitative and qualitative research into the *Factors affecting public engagement by researchers* carried out in the spring and early summer of 2015. Public engagement is a relatively novel – yet, increasingly important – concern for researchers. Within this context, the objectives of the primary research are to understand recent change in this domain from the perspective of researchers and public engagement ‘enablers’ or professional support staff, and to provide evidence for future planning and policy in the context of public engagement. To a considerable extent, the 2015 research is understood as an update of the work that was led by the Royal Society ten years ago (Royal Society, 2005; 2006). The research is funded by a Consortium of 15 funders of UK public research³. The Wellcome Trust has managed the research on behalf of the Consortium supported by a Steering Group drawn from the Consortium. The project reports are available at www.wellcome.ac.uk/PERSurvey

Objectives of the literature review

The objectives of the literature review are:

1. To provide an independent review and synthesis of existing research and literature relating to: the attitudes, understandings and experiences that are expressed by researchers themselves, and recent changes in the systems of reward and support for public engagement.
2. To inform and provide a context for the 2015 empirical work, in support of future planning by the Consortium.

³ The Consortium comprises: Wellcome Trust, Royal Society, British Academy, Royal Academy of Engineering, Academy of Medical Sciences, Royal Society of Chemistry, United Kingdom Research Councils, Higher Education Funding Council for England, Higher Education Funding Council for Wales, Scottish Funding Council, Department for Employment and Learning – Northern Ireland, Department of Health (NIHR), the Scottish Government, Department for Business, Innovation and Skills and the Welsh Government (National Institute for Social Care and Health Research). The research is also supported by Universities UK.

Methodology

The relevant literature was identified via the following methods:

- Liaison with actors in the public engagement domain.
- Purposive searches of the websites of the funding Consortium and other relevant institutions (e.g. the National Coordinating Centre for Public Engagement and the ex-Beacons for Public Engagement).
- Purposive searches of key academic journals (e.g. Public Understanding of Science, Science Communication, and Science and Public Policy).
- Searches in databases and search engines.

The materials were analysed through close and repeated reading with the support of a qualitative analysis software package, Atlas.ti. Following the principles of thematic analysis, themes within the literature were derived based upon the pre-existing interests of the funders and – to a lesser extent – from the literature itself (Boyatzis, 1998). In some cases, further basic statistical analysis was undertaken by the author of this report.

Summary of the 'Factors affecting' materials

The literature search has yielded around eighty items. While some earlier literature was identified in bibliographies, the available literature dates from 1985 and continues to the present. The literature is highly diverse. It addresses a variety of disciplinary populations, for instance: all researchers, scientists and engineers, specific scientific disciplines variously defined and so on. In this context, some 60% of the items specifically focus on the STEM disciplines and the others are cross-disciplinary. The literature employs both quantitative survey methodologies and qualitative interview methodologies. The studies are undertaken with a wide range of objectives and using a wide range of survey instruments and interview topic guides. Further, the literature defines its topic of study in a variety of ways that reflect the historical development of the public engagement agenda over thirty years. Typically, in the earlier materials (which focus on the STEM disciplines), this implies topics or terms, such as: science communication, public understanding of science, public debate, outreach, popularisation and so on. In more recent work, whether in the STEM disciplines or across disciplines, the topic of study is increasingly understood as public engagement; however, this is not necessarily defined in the way that it is defined by the Consortium, and often focuses on the more communicative elements of public engagement including media work. With these complexities in mind, efforts are made throughout the review to locate the materials within particular disciplines and associated framings of public engagement.

Since this is a live policy issue, academic research published in journal articles (around 50% of the total) is complemented by a large grey literature consisting of work by academics, public engagement and evaluation professionals, and commercial researchers (around 50% of the total). While there is no particular reason to doubt it, the quality of some of this grey literature cannot be assumed because it has not been subjected to peer review. For this reason, some of the grey literature has been treated with some caution. It is also important to note that while quantitative research in this domain provides useful frequency data, very often inferential tests are not carried out. That said, items that might fall into these categories tend to reach broadly similar conclusions to more reliable work.

Reflecting the particular policy emphasis on public engagement in the UK, the grey literature in this review focuses predominantly on the UK. The academic literature is more international, also focusing in particular on the US and other European countries, and with recent more global forays. Longitudinal studies are rare: some are available in the context of the Beacons for Public Engagement. In addition, the Careers in Research Online Surveys (Vitae-CROS, 2009; 2011; 2013; 2015), the Principal Investigators and Research Leaders Surveys (Vitae-PIRLS, 2011; 2103; 2015) and the Higher Education-Business and Community Interaction surveys (HEFCE, 2015) each offer opportunities for longitudinal analysis, though these studies employ a convenience sample. To augment this, Vitae was contracted to produce cross-tabulations (relating to seniority, gender and discipline) for the 'public engagement' questions in the CROS and PIRLS studies.

It is this range of disciplinary populations, and framings of public engagement and its forebears – as well as the methodological challenges – that shapes the unclear, complex and somewhat confused picture that is presented by the literature. This complexity serves to underline the value of the 2015 empirical work, which is conducted across academic disciplines, is based upon a well-defined framing of public engagement (while also allowing researchers to define public engagement themselves) and is methodologically rigorous.

Structure of the report

The report contains five substantive chapters. Chapter 2 focuses on the historical policy context for public engagement since 1985. In particular, this chapter describes the contrasting backgrounds for public engagement that pertain in different research disciplines. Crudely, while earlier developments in the STEM disciplines (science, technology, engineering and mathematics) place an emphasis on communication and education, developments in the arts, humanities and social sciences feature a greater emphasis on participation, collaboration and empowerment. These distinctions are important because they appear to inform the contemporary landscape. In Chapter 3, the emphasis

is on the ambiguous ways in which public engagement (and its precursors) is considered as important by researchers, but not as important as research itself. This chapter also considers the evidence for the extent of researcher participation in public engagement over time, and the demographic attributes of engagers. Chapter 4 focuses on the wide range of activities, objectives and motivations that researchers cite when discussing public engagement (and its precursors). It is here that the historical distinctions that were discussed in Chapter 2 may be relevant to the contemporary scene. In Chapter 5, a number of barriers to greater participation in public engagement are discussed. In particular, issues and practical responses relating to 'reward and recognition', and 'skills, confidence and training' are discussed. Chapter 6 focuses on the limited literature relating to the views of public engagement 'enablers' (the providers of professional public engagement services) and the senior managers of academic institutions.

In Chapter 7, some of the implications of the review findings are discussed. In particular: context is provided for the apparently stable levels of research participation in public engagement in recent years; the potential for segmentation in future public engagement strategies is discussed; the role of media work in definitions of public engagement is examined; and, the need for more comprehensive and consistent evaluation of public engagement programmes and activities is explored.

2 The public engagement policy context

This chapter provides detail on four key issues: the deepening institutional commitment since 1985 to the idea that interaction between research and society is a good thing; the institutionally-driven focus on public acceptance, communication and education that prevailed in the STEM disciplines from 1985 to around 2000; the more researcher-driven emphases on performance and participation in the arts and humanities, and participation and empowerment in the social sciences, that emerged over a similar period; and, the ways in which these two agendas have been brought together under the rubric of public engagement since around 2003. The distinctions between the STEM subjects and the others, prior to 2000, is important because it appears to inform the contemporary public engagement landscape.

Introduction

Over the past 30 years, led by developments in the UK and mirrored in other countries, the relationships between researchers and broader society or the public have been the subject of increasingly concerted attention from the institutions that govern and fund research. Since the early/mid 2000s, the term 'public engagement' has emerged as a widely-used and highly flexible umbrella term to encapsulate the wide range of objectives, approaches and activities that might be evoked or employed as part of these efforts. Since this time, official commitment to public engagement has deepened, and public engagement activities have – at least in some quarters – become more institutionalised and professionalised across academic disciplines. Although this agenda has varied origins and has evolved over time, it is notable that one of its core assumptions has remained more-or-less constant throughout: mutually supportive relationships between research and society are important for both. Further, such relations are best ensured through high levels and varied forms of interaction or engagement between the two. The earlier phases of this agenda proceeded in two distinct streams that can be fairly straightforwardly identified with the STEM disciplines (science, technology, engineering and mathematics) and the arts, humanities and social sciences. It is helpful to understand the distinctions between these agendas because they will have a legacy in the context of the views and experiences of contemporary researchers with respect to public engagement.

Earlier developments in the STEM disciplines

Examples of public-facing activities and programmes can be found throughout the 20th century and, arguably, earlier (Gregory and Miller 1989). However, in the context of the STEM disciplines, contemporary attention to this issue was instigated by the *Public Understanding of Science* (PUS) or Bodmer report (Royal Society, 1985). Prompted by perceived crises of public support for scientific and technological developments, and based upon faith in the maxim *to know science is to love it*, this agenda focused on public education about science in the form of one-way science communication. In the same year, the Committee on the Public Understanding of Science (COPUS) was set-up – by the then British Association for the Advancement of Science (now the British Science Association or BSA), The Royal Society and the Royal Institution – to further the PUS agenda. Over the following years, the ‘public understanding’ agenda was reinforced in official documents⁴, began to be supported by specific actions relating to reward and training, and consolidated around so-called outreach activities (such as: media work, public lectures and debates, writing for lay audiences, science festivals, work with museums and schools, and open lab events). A decade and a half later, the agenda was reinvigorated and redirected by the House of Lords Science and Technology Select Committee’s *Science and Society* report (House of Lords, 2000). While this report retains earlier concerns about a lack of public support for developments in science and technology, it shifted the focus onto public trust, and identified a need for two-way dialogue and engagement with the public or society. In the years after 2000, a novel Science and Society (S&S) agenda has been supported and developed in a number of governmental and institutional reports⁵. Within this agenda, the list of relevant activities was explicitly extended to include the involvement of the public in research in citizen science projects, and a range of deliberative or dialogue processes within specific policy-development contexts. In this context, the establishment in 2007 of the Sciencewise resource for public dialogue and deliberation is a notable development (Sciencewise, 2015). Reflecting the continued importance of media work, another significant development was the establishment of the Science Media Centre in 2002. At the same time, from the early/mid 2000s, these STEM agendas have also been subsumed into the broader public engagement agenda, which is discussed below⁶.

4 Such as the science white paper *Realising our Potential* (Cabinet Office, 1993) and the Wolfendale Report (1995).

5 Among others, see: Parliamentary Office of Science and Technology (POST) (2002, 2006); Royal Society (2001, 2004); The British Association for the Advancement of Science (2002, 2005); HM Treasury et al. (2004); Office of Science and Technology (2004); Royal Society and Royal Academy of Engineering (2004); Council for Science and Technology (2005); UK Government (2005); Office of Science and Innovation (2006); DIUS (2008); BIS (2009; 2012; 2014).

6 See the social science commentaries of Bauer et al., 2007; Burchell et al., 2009; Irwin 2006; Miller, 2001; Stilgoe et al., 2014; Watermeyer and Lewis, 2015; Wynne 1992; 2006.

Early developments in the arts, humanities and social sciences (AHSS)

Although not promoted through high level institutional reports in the manner of the STEM disciplines, a range of similar kinds of outreach activities have been undertaken in the arts, humanities and social sciences over many years. For instance, media work, public lectures and debates, writing for lay audiences, literary and arts festivals, and work with galleries and schools were all part of this landscape (see examples in Levitt et al., 2010; Hughes et al., 2011).

In the social sciences (and to some extent the arts and humanities), a number of similar – though rather different to those in the STEM disciplines – engagement agendas were emerging in the latter years of the twentieth century; for instance, *community-based participatory research* (Minkler and Wallerstein, 2003; 2008; Israel et al., 2005), *action research* (Reason and Bradbury, 2001) and *community research* (Goodson and Phillimore, 2012) (from an institutional perspective, see examples in Hughes et al., 2011). In these domains, research is undertaken by researchers in the context of collaborative action or co-enquiry by researchers and social groups, and the objective of the research and action is a blend of mutual learning, development and empowerment. These forms of research are typically undertaken within the context of social issues (such as: health, migration, race and ethnicity, community development and sustainability), and it is notable that – in contrast to the STEM disciplines – these agendas emerged largely independently of official institutions. In the more recent public engagement era, these activities too have been incorporated into the official public engagement rubric.

The public engagement era

Increasingly widespread use of the term *public engagement* can be discerned from around 2002/2003. Since this time the UK funders of public research have gradually re-oriented their activities around this term and its definitions, and have deepened their commitment to the institutionalisation and professionalisation of public engagement within UK higher education and other research institutes. In this way, public engagement has become a novel and increasingly important activity for all UK universities and for many UK academic researchers across all academic disciplines. Central to these efforts, in 2008, Research Councils UK and the Wellcome Trust established the National Coordinating Centre for Public Engagement (NCCPE)⁷, which now states its purpose as,

‘To support a culture change in the HEI sector. Our vision is of a higher education sector making a vital, strategic and valued contribution to 21st-century society

⁷ The UK Higher Education Funding Councils have also part-funded the NCCPE.

through its public engagement activity. Our mission is to support universities to increase the quality and impact of their public engagement activity' (NCCPE, 2015).

The NCCPE provides expert advice, training and tools, and pays particular attention to the ways in which higher education institutions promote, incentivise, support and evaluate their public engagement activities (these issues are discussed in more detail later). In further support of these aims, these institutions (plus the Scottish Funding Council) also funded six regional university-based Beacons for Public Engagement from 2008-2011 with the objective to inspire a culture change in how universities engage with the public (NCCPE, 2015).

Although official definitions of public engagement have evolved over time and are varied, the NCCPE now defines it as,

'the myriad ways in which the activity and benefits of higher education and research can be shared with the public. Engagement is by definition a two-way process, involving interaction and listening, with the goal of generating mutual benefit', and notes the links with the associated terms, 'civic engagement' and 'community engagement' (NCCPE, 2015).

In 2010, Research Councils UK led on the publication of a Concordat for Engaging the Public with Research – a statement of a shared vision and objectives for public engagement, as well as a commitment to support public engagement activities (Research Councils UK et al., 2010⁸). This document defines the term by providing a list of the activities that it considers constitute public engagement:

Public engagement with research describes a diversity of activities including:

- Participating in festivals
- Working with museums / galleries / science centres and other cultural venues
- Creating opportunities for the public to inform the research questions being tackled
- Researchers and public working together to inform policy
- Presenting to the public (e.g. public lectures or talks)
- Involving the public as researchers (e.g. web based experiments)

8 Along with Research Councils UK, the following institutions were signatories to the Concordat: Higher Education Funding Council for England, Higher Education Funding Council for Wales, Department for Employment and Learning (DEL), N. Ireland, Scottish Funding Council, The British Academy, The Royal Academy of Engineering, The Royal Society and Defra. The Concordat was supported by a further 31 organisations (Research Councils UK et al., 2010: 5).

- Engaging with young people to inspire them about research (e.g. workshops in schools)
- Contributing to new media enabled discussion forums (Research Councils UK et al., 2010: 4)

Reflecting a desire to emphasise the two-way characteristics of public engagement, it is notable that this list encompasses all of the activities that were mentioned in the previous sections except for work with traditional media and journalists. This activity was included in the definition of public engagement that was provided by the then Department of Innovation, Universities and Skills (2008: 20), but has not been part of official definitions since 2010 (also see the discussion of definitions of public engagement and associated terms in Illingworth et al., in review).

From 2013 to 2015, Research Councils UK has funded eight university-based Public Engagement with Research (PER) Catalysts. These projects are designed to draw on and develop the learning from the Beacons for Public Engagement programme, with the overarching aim of embedding a culture within universities where public engagement with research is strategically planned, systematically assessed, valued and recognized (Research Councils UK, 2011a; NCCPE, 2015). In 2015, Research Councils UK (2015a) will fund a further ten institutions for 12 months from its Catalyst Seed Fund.

In recent years, the public engagement agenda has been augmented by two associated policy trajectories. First, in the UK, an important 'impact' agenda has emerged. In this context, public engagement is a sub-category within a broader notion of 'impact' outside of the academy, which also includes impact on, 'economy, society, culture, public policy or services, health, the environment or quality of life' (HEFCE, 2011, p.71). The 'impact' agenda appears in two key guises. One is the 2014 Research Excellence Framework, the system through which university research quality and 'core' government funding are determined, which includes an 'impact' element (accounting for 20% of the overall score) for the first time (HEFCE, 2011; Grant et al., 2015)⁹. The other is the requirement in funding bids to Research Councils UK for a two-page *Pathways to Impact* statement (Research Councils UK, 2015b) and to record impact in the on-line researchfish system (2015). This development, too, is leading to the emergence of new professional categories within higher education institutions. Second, since 2010, public engagement is highlighted as the most important element within the *Responsible Research and Innovation* and *Science with and for Society* frameworks that are promoted by the European Commission (the other elements are: open access, gender, ethics, science education) (European Commission, 2015)¹⁰.

⁹ See the social science commentaries of Collini (2009); Franklin (2010); McKibben (2010); Smith et al. (2011); Watermeyer (2011; 2014a/b; forthcoming a/b).

¹⁰ See the social science commentaries of Owen et al.. (2012); Stahl (2013).

3 Importance, extent and demographic attributes

In this chapter, three key themes are explored: the ambiguous ways in which researchers consistently reflect upon public engagement (and its precursors) as an activity that is important, but not as important as research (and some other activities); the mixed evidence that suggests that the extent of public engagement is either stable or increasing in some quarters; and, the consistent evidence that more public engagement is undertaken in the arts, humanities and social sciences (than in the STEM disciplines), as well as the more mixed evidence with respect to gender and seniority.

The ambiguous importance of public engagement

Within the context of science communication, one of the ways in which Royal Society (1985: 6) emphasised its importance was to state that scientists have a 'duty' 'to communicate with the public'. Research into researchers' views – or, in this context, typically scientists' views – suggests that many share this sentiment: 84% of UK bioscientists (Wellcome Trust, 2000: 21); 69% of UK scientists and engineers (Royal Society, 2006: 32); 67% of researchers at UCL (FreshMinds, 2008); 80% of scientists (Crettaz von Roten, 2011: 60: Switzerland). In Kreimer et al. (2011: 41: Argentina), more respondents cited 'duty' *first* than any other motivation (16%). Qualitative works adds some flesh to these quantitative bones, noting in particular that scientists typically frame this as a reciprocal duty in the context of the funding that they receive from general taxation, or from charities and patient groups (Royal Society, 2005; Burchell et al., 2009; Bultitude et al., 2012; Porter et al., 2012). In Pew Research Center (2015: 3) – a large-scale survey of researchers across ALL disciplines associated with the American Association for the Advancement of Science (AAAS) – 87% agreed with the statement "Scientists should take an active role in public policy debates about issues related to science and technology" (though the reasons for this are not clear).

In the public engagement era, its importance has been stressed by ambitions for it to be embedded with research cultures (Research Councils UK et al., 2010; NCCPE, 2015). As discussed earlier, six Beacons for Public Engagement were funded from 2008-2011. As would be expected, perhaps, the final evaluations and reports from these programmes suggest that, when senior institutional commitment and targeted funds are directed towards public engagement, this has benefits in terms of institutional structures, systems of support and knowledge sharing, and levels of activity and impact (Chapman and Mancini, 2011; Stinton and Band, 2011; Edinburgh Beltane Beacon, 2012; EKOS-Manchester

Beacon, 2012; Hussain and Moore-UCL Beacon, 2012; Beacon NE, 2013; Beacon for Wales, 2013; CUE East, 2013; Moore, 2014). At the same time, these programmes hint at the extended periods of time over which institutional and organizational change takes place. In addition, they tell us little about the broader potential for change in other institutions around the country in the absence of the dedicated Beacons for Public Engagement funding (or the more recent PER Catalyst and Catalyst Seed Fund funding).

However, this sense that science communication or public engagement is so important that it is a duty becomes muddled when the other professional responsibilities of scientists – and the strong sense of time-pressure that many researchers express – are brought into the picture. Burchell et al. (2009: 54) cite the example of a senior UK scientist who argues that good communication is as important as good science within a team, and all of the bioscientists in that study indicated that public engagement had become more important over the years. However, the broader evidence is much more mixed. In Royal Society (2006), when scientists and engineers were asked about the importance of engagement in relation to other professional activities, 52% question its relative importance (p30) and 64% indicate that the time for engagement is limited due to the relatively greater importance of research (p38) (time for engagement is returned to later). In the 2011 Principal Investigators and Research Leaders Survey, 71% cite public engagement as 'very important' or 'quite important' to being a research leader. However, this is one of the lowest scores in the battery. The corresponding figures for ten items directly related to research are all in the upper 90% and knowledge exchange scores 73%. Only items relating to training, induction and appraisal, and conditions of employment score lower than public engagement (teaching is not in the battery) (Vitae-PIRLS, 2011: 29). In the 2013 survey, this question is phrased differently, but the same pattern is discernable (Vitae-PIRLS, 2013: 23). The theme of a professional environment that is overwhelmingly driven by the need for high quality research outputs also emerges in qualitative work over an extended period (Gascoigne and Metcalf, 1997; Royal Society, 2005; Burchell et al., 2009; Hughes et al. 2011; Porter et al., 2012; Hussain and Moore-UCL Beacon, 2012; Watermeyer, forthcoming a/b). For instance, a scientist quoted in Royal Society (2005: 8) suggests that it is essential to 'Build a career on hard research' and Porter et al. (2012: 417) cite a scientist's comment, 'communicating your science is no substitute for producing good science'. In many of these accounts, this relative unimportance of public engagement is framed in the context of a professional life in which time is always in short supply and what an interviewee in Burchell et al.'s (2009) study referred to as 'an 80-hour week'. Recent qualitative work in the broader context of 'impact' reinforces this picture. On the basis of interviews with social scientists, Watermeyer (2014a) concludes 'impact' activities cannot typically compete for time and resources in a research-driven profession. Watermeyer (2014a) further suggests that public engagement holds a rather lowly position in the 'impact' hierarchy, seen as less prestigious and important than economic or policy impact.

On the basis of qualitative research with forty researchers who are deeply involved in public engagement, Watermeyer (forthcoming a) provides a more nuanced analysis. Watermeyer describes a group of researchers who have a 'clear and specific' understanding of what public engagement means and considerable commitment to that. However, these researchers – Watermeyer continues – find themselves almost 'lost' between their own position, and what they see as the ambiguous meanings and low commitment to public engagement that they encounter at the institutional level and the eclectic meanings and fluctuating commitment that they perceive amongst the funders of research. At the same time, researchers also comment on the valuable sense of agency, autonomy and volunteerism that they feel with respect to their public engagement activities (Burchell et al., 2009; Watermeyer, forthcoming b). With researchers' reflections on these tensions and ambiguities in mind, commentators have suggested that public engagement and its precursors are: 'optional not basic' (Gascoigne and Metcalf, 1997: 267), 'a professional anomaly' (Burchell et al., 2009: 7); 'a marginal call' (Bauer and Jensen, 2011: 8); problematic in terms of being a 'good scientist' (Porter et al., 2012: 408); and a 'third space' in which researchers are 'lost' (Watermeyer, forthcoming a).

This ambiguity is also reflected in what limited research there is at a specifically institutional level. Neresini and Bucchi (2011) carried out institutional research in forty European research institutes. The study reveals a wide range of levels of commitment to public engagement and that support for these activities is not yet considered essential in many cases. In this study, while individuals reflected on the need for evaluation, this was evident in only very few cases. In their small-scale study, Grand et al. (2015: 9) also note that the evaluation of public engagement is something of a blind spot among researchers: here, 42% of respondents report an absence of evaluation, while 41% report using highly informal or anecdotal methods, and only 5% report using formal or semi-formal approaches to evaluation.

The extent of public engagement

A key question, then, is the extent to which levels of public engagement have changed over time. In the UK, a small number of large-scale surveys and in-depth qualitative studies have attempted to address this question. On the quantitative side, the four UK Career Researchers Online Surveys (CROS) consistently placed researcher involvement in public engagement at 40% in 2009, 2011 and 2013, with an increase to 44% in 2015 (Vitae, 2009: 38; 2011: 33; 2013: 10; 2015).

In the 2015 CROS data, a further 39% said that they would like to participate in public engagement and 18% said they had no current interest in public engagement¹¹.

In addition, the Higher Education-Business and Community Interaction survey (HE-BCI) has attempted to measure the extent of what it refers to as 'social, community and cultural activities' – such as public lectures, performance arts events (music, dance, drama etc.), exhibitions (galleries, museums etc.) and museum education – by UK higher education institutions (see all reports and data at HEFCE, 2015). Since 2007-8, it has done this by asking for information about, first, the numbers of attendees at events (Table 1) and, second, the number of days that are devoted to such activities by staff (Table 2). As is acknowledged in the yearly reports, these are not reliable proxies for understanding the extent of public engagement by researchers, yet they are of some value because they provide a longitudinal picture. As Table 1 shows, the recent increases in the reported numbers of attendees at such events is striking; more than 100% between 2010-11 and 2012-3, and 62% from 2011-12 to 2012-3. The data in Table 2 is not as varied, which might mean that the time-efficiency of such activities is improving.

More historically, in the biosciences, Wellcome Trust (2000: 33) suggests that 56% of researchers had participated in communications activities over the previous year, while BBSRC (2014: 1) suggests that the percentage of its funded scientists who are involved in public engagement increased from 76% to 83% from 2005 to 2014. Looking at specific activities, although comparison must be treated with extreme care due to differences in the wording of the questions and the population, the Wellcome Trust (2000: 33) and Royal Society (2006: 26)¹² studies show evidence of increased involvement among scientists over this period. For instance, participation in public lectures shows an increase from 32% to 41%, participation in an institutional open day from 24% to 57% and writing for lay audiences from 13% to 25%. These cautious observations of increases – in some quarters – in the extent to which public engagement activities are undertaken by scientists is also reflected in smaller-scale UK qualitative studies, such as Squirrell's (2007) work with scientists and engineers, and particularly in Burchell et al.'s (2009) work with researchers in the biosciences who are experienced in public engagement. The senior UK researchers in this study all referred to a landscape in which more public engagement activity was undertaken than in the past.

Further afield, in Norway, Kyvik (2005) presents evidence that suggests that *across all disciplines* the percentage of researchers who had published materials

11 While the Vitae CROS survey is aimed at more junior researchers, more senior researchers are directed towards the Vitae Principal Investigators and Research Leaders survey (PIRLS) which does not gather data about the extent of participation in public engagement. The 2015 data is not yet published.

12 Royal Society (2006) focuses on 'scientists and engineers'.

Attendees (100 millions)

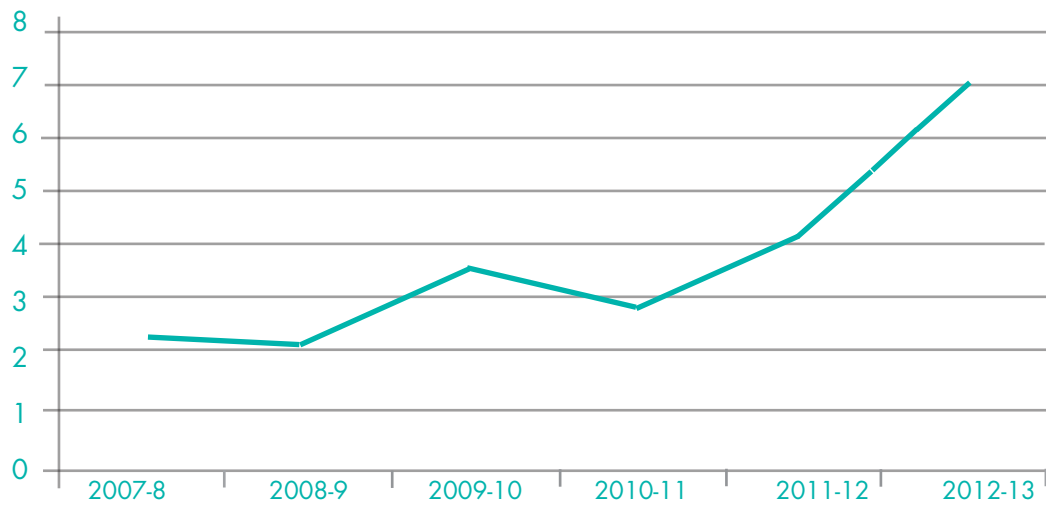


Figure 1. Numbers of attendees at social, community and cultural events, 2007-8 to 2012-13 (all reports and data at HEFCE, 2015).

Days (100 thousands)

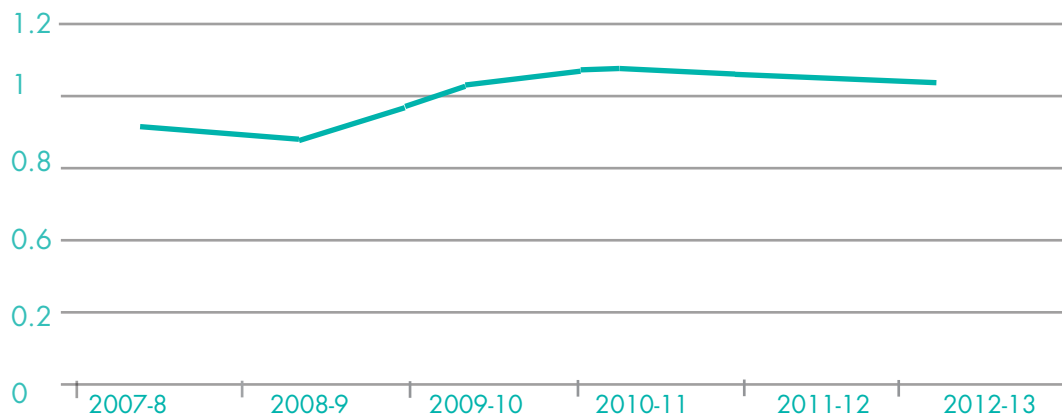


Figure 2. Days devoted to social, community and cultural activities, 2007-8 to 2012-13 (all reports and data at HEFCE, 2015).

for lay audiences increased from 48% to 51% between 1989-1991 and 1998-2000 and that contributions per researcher also increased. In France, Jensen (2011: 31) suggests that the numbers of researchers involved in public engagement across all disciplines has increased from 26% to 35% between 2004 and 2009 (and that participation per researcher also increased). In a very recent US report which focuses on researchers across ALL disciplines associated with the AAAS and on media work, no change in extent of involvement is noted between 2009 and 2014 (Pew Research Center, 2015: 14)¹³.

The literature suggests that levels of public engagement are, at least, not declining and there are grounds to cautiously suppose that they are increasing.

The demographic attributes of engagers

The research into the characteristics or attributes of the researchers who undertake public engagement tends to focus on two elements: demographic attributes (such as discipline, gender and seniority), and attitudes towards public engagement (such as regarding it as valuable or expressing a lack of confidence). This section focuses on demographic attributes. While a variety of attitudinal issues are addressed in the chapters below, the role of a positive attitude towards public engagement can be addressed here. Employing the approaches associated with the Theory of Planned Behavior, studies have observed that – perhaps not surprisingly – researchers who have more positive attitudes towards public engagement are more likely to undertake such activities (Poliakoff and Webb, 2007; Dudo, 2012: US¹⁴).

With regards to academic discipline, evidence from around the world in a range of contexts suggests greater levels of public engagement in the arts, humanities and social sciences (AHSS) than in the STEM disciplines. Most significantly in the UK context, the CROS surveys of more junior researchers consistently indicate levels of participation in the STEM disciplines to be between 30% and 44%, and levels of participation in the arts, humanities and social sciences between 50% and 60% (Vitae-CROS, 2009; 2011; 2013; 2015)¹⁵. This finding is also reflected in: small-scale research undertaken in UCL at the inception of the UCL Beacon for Public Engagement (FreshMinds, 2008) (in this study, some researchers also commented that the work of some departments is more amenable to public engagement than that of others); Kyvik (2005: Norway), Jensen (2011: France); Kreimer et al. (2011: Argentina) and Pew Research Center (2015: 19)¹⁶. In a US study within the sciences (Besley et al., 2013),

13 These papers do not present inferential tests.

14 Dudo's (2012) study is carried out in the context of scientists and science communication.

15 The cross-tabulations by discipline were specially commissioned from Vitae and do not appear in the published reports.

16 This study also identifies earth scientists as the most prolific engagers.

greater engagement with the media is noted in mathematics and engineering, and less in chemistry. Perhaps mirroring the findings in FreshMinds (2008), Pew Research Center (2015: 17-8) suggests that there is greater media engagement among researchers who believe that there is more media coverage of – and public interest in – their topic.

Further, a recent analysis of the impact case studies in the 2014 Research Excellence Framework suggests that public engagement was much more prevalent in case studies from the arts and humanities (21%¹⁷ of the total within that Panel) than it was in case studies from other disciplines (2%) (King's College London and Digital Science, 2015). To express this pattern in another way, 77% of the impact case studies that included public engagement were submitted in the arts and humanities. While these are striking figures, it should obviously be borne in mind that the corpus of impact case studies that was analysed in this research is not representative of the entirety of either the impact activities or the public engagement activities that are undertaken by UK researchers.

Both quantitative and qualitative research consistently points towards – in the sciences, at least – a relationship between academic success (in terms of seniority and academic productivity) and participation in engagement activities (Wellcome Trust, 2000: UK; Kyvik, 2005: Norway; Royal Society, 2005; Jensen et al., 2008: France; Burchell et al., 2009; Dunwoody et al., 2009: US; Bauer and Jensen, 2011: UK; Bentley and Kyvik, 2011: 13 countries¹⁸; Jensen, 2011: France; Dudo, 2012: US; Besley et al. 2013: US; Pew Research Center, 2015). That said, the reverse appears to be the case in Spain where junior researchers appear to undertake more engagement (Torres Albero et al., 2011). Interestingly, Pew Research Center (2015: 16) suggests that, while public engagement through traditional media increases with age, engagement through social media decreases with age¹⁹. In some studies, the long-standing pressures on younger, more junior researchers to establish a strong research track record from the start are said to be doubly compounded by novel imperatives towards public engagement (e.g. Royal Society, 2005; Burchell et al., 2009).

Turning to gender differences, a mixed picture emerges. In the UK, earlier CROS surveys of more junior researchers indicate very slightly greater participation in public engagement among women (Vitae-CROS, 2009; 2011; 2013)²⁰. More specifically, in the 2011 and 2013 surveys, participation among women is just over 40% while participation among men is just below 40%; the reverse is true in the 2009 survey. However, the 2015 data points to the possibility of a more

17 These figures do not feature in the report (King's College London and Digital Science, 2015), but were calculated by Dr Burchell, based upon data in an accompanying Excel spreadsheet, and verified with one of the report's authors, Dr Saba Hendrichs.

18 Argentina, Australia, Brazil, Canada, Finland, Germany, Hong Kong, Italy, Malaysia, Mexico, Norway, the UK and the US.

19 In the quantitative papers, these differences are typically statistically significant.

20 The cross-tabulations by discipline were specially commissioned from Vitae and do not appear in the published reports.

sizeable difference: 47% for women and 41% for men. This general pattern is also reflected in two studies that focus on the sciences (Jensen, 2011: France; Johnson et al., 2013: US), though gender was not associated with participation in Dudo (2012: US). However, a number of studies that focus on the sciences highlight higher levels of public engagement among male scientists (in some cases, even after seniority is taken into account) (Wellcome Trust, 2000: UK; Crettaz von Roten, 2011: Switzerland; Kreimer et al., 2011: Argentina; Besley et al., 2013: US). Andrews et al. (2005) focus on the outreach activities of geoscience research students; this work is interesting because participation among female research students was greater than among the males, and it hints at the possibility that women's participation might decline with seniority.

4 Activities, objectives and motivations

Four key points emerge from this chapter. Researchers refer to a wide range of activities, objectives and motivations with respect to public engagement. While these tend to focus in some way on relationships between research and society, some personal and institutional matters are also reflected. In the context of the STEM disciplines, there is evidence that earlier objectives relating to public acceptance, communication and education still prevail in the context of public engagement. Although media work is not included in some contemporary definitions of public engagement, this remains a relevant and important activity in the minds of many researchers.

The activities of public engagement

Since the Concordat for Engaging the Public with Research (Research Councils UK et al., 2010) defines public engagement in terms of its activities, it is of value to try to understand the extent to which researchers' views might align or diverge from this definition. In this section, the focus is on researchers' understandings of the activities of public engagement, and the objectives of public engagement are discussed below in the context of motivations. The Concordat for Engaging the Public with Research defines public engagement in terms of examples of activities, such as: participating in festivals; working with museums / galleries / science centres and other cultural venues; creating opportunities for the public to inform the research questions being tackled; researchers and public working together to inform policy; presenting to the public (e.g. public lectures or talks); involving the public as researchers (e.g. web based experiments); engaging with young people to inspire them about research (e.g. workshops in schools); and, contributing to new media enabled discussion forums (Research Councils UK et al., 2010: 4).

Some of the research that investigates the different kinds of activities that researchers undertake in the context of public engagement focuses on the STEM disciplines (Wellcome Trust, 2000; Royal Society, 2006; Burchell et al., 2009), and some addresses all disciplines in the context of the Beacons for Public Engagement and the PER Catalysts (FreshMinds, 2008; Stinton and Band, 2011; Moore, 2014; Grand et al., 2015). Taken together, this work suggests that researchers and institutions understand and conduct a wide range of activities within the context of public engagement; one might say that researchers often understand public engagement to refer to all of their activities that are non-research/teaching/administration/(clinical). To some extent, these activities align

with those that are identified in Research Councils UK et al. (2010). For instance, the literature suggests that public lectures or talks and working with schools are two of the most important and common activities among researchers (40% and 30% respectively in Royal Society, 2006: 26; also see Burchell et al., 2009). In addition, in two more recent studies – both of which were undertaken in contexts in which more sophisticated understandings of public engagement might be expected – the more dialogic approaches that are identified by Research Councils UK et al. (2010) also feature in accounts of public engagement, though often not as strongly as the more communicative activities mentioned above (Burchell et al., 2009; Stinton and Band, 2011; Grand et al., 2015).

At the same time, the research indicates that researchers' understandings of the activities of public engagement differ from Research Councils UK et al. (2010) in a number of respects. First, and most significantly, work with the media and journalists figures highly in researchers' priorities and activities in all of these studies. It is not easy to identify a percentage as was done above because – perhaps in a statement of its significance – studies tend to break this activity down into component parts (e.g. print media, TV and radio) and sometimes merge this category with others. Second, student recruitment and knowledge transfer often feature in researchers' understandings of public engagement. Finally, although working with policy-makers often features strongly in researchers' understandings of public engagement (for instance, Burchell et al., 2009), this is not necessarily envisaged as being in collaboration with the public as indicated in Research Councils UK et al. (2010).

Objectives and motivations

In summary, the literature suggests that individual researchers tend to have a range of motivations and objectives in mind when they conduct public engagement, usually simultaneously. The research also suggests public engagement is undertaken by researchers as a group with an extremely wide range of objectives. The literature also expresses these in a variety of ways that can make direct comparison difficult. In this section, motivations related to the relationships between research and society, personal motivations relating to satisfaction and enjoyment, and institutional motivations are addressed (while these are often interlinked, it is possible to separate them out to some extent). Since it is such an important topic, personal motivations relating to reward and recognition are dealt with in a separate section below.

Relationship between research and society

Many of the objectives and motivations for public engagement that are expressed by researchers relate in some way to impacting the relationship between research

and society. There is considerable interest – particularly in the STEM disciplines, but also more broadly – in the extent to which scientists’ motivations for public engagement are transitioning from the communication-oriented objectives that are associated with public understanding of science to the complementary dialogic concerns of public engagement. While some of the UK literature on scientists’ attitudes suggests that changes are taking place in some quarters, more broadly this remains a mixed and complex picture.

Given that the Wellcome Trust (2000) study coincides with the earliest emergence of the public engagement agenda, it is perhaps not surprising that reflections of the more dialogic actions and objectives of the agenda are absent even from the survey questions. Six years later in Royal Society (2006: 28) and fourteen years later in BBSRC (2014: 5), the one-way communication model of public engagement is strongly reflected. In both of these surveys, items relating to ‘public information’ and ‘public awareness’ emerge as around twice as significant in scientists’ minds as items that hint at a more dialogic model, such as ‘To be accountable for the use of public funds’ or ‘contributions to public debate’ (the latter, only in Royal Society, 2006). Turning to smaller case studies, similar conclusions can be drawn from Duensing et al.’s (2008) work at a Royal Society Summer Science exhibition, Tøsse’s (2013: Norway) case study on the media strategies of climate scientists, and Bultitude et al.’s (2013) report in the context of the Festival of Neuroscience.

A number of recent qualitative UK studies have been carried out among groups of scientists who are probably more experienced in public engagement than is typical. These indicate that although change is taking place, the terrain is mixed and complex. For instance, some interviewees use the terms science communication, public understanding of science, outreach and public engagement interchangeably (Burchell et al., 2009; Davies, 2013). Other studies also indicate a lack of clarity among scientists and researchers regarding these terms (BBSRC, 2014). Sometimes, the dialogic activities of public engagement are understood merely as *better* ways of achieving the still primary educative objectives associated with public understanding of science (Burchell et al., 2009; Parry et al., 2012; Davies, 2013). Nonetheless, these studies do qualitatively suggest that such a transition is taking place (also see Squirrel, 2007; Stinton and Band, 2011). The most intensive examination of this issue is to be found in Burchell et al.’s (2009) work with bioscientists who are experienced in public engagement. Here, interviewees’ discussions often reflected institutional discourses relating to: rejection of public understanding of science models, changes in the relationship between science and society, the need for new models of engagement, and a range of novel objectives (including participatory policy-making, learning about social and ethical issues, learning about medical conditions from patients and carers, and improving science by seeing the ‘big picture’ that is held by society). To this extent, it would appear that scientists’ understandings are beginning to align with institutional ambitions in some specific contexts.

A number of studies address this issue within the context of the UK Beacons for Public Engagement and the PER Catalysts (McDaid, 2008; Stinton and Band, 2011; Davies, 2013; Grand et al., 2015). While these might be unusual cases due to the emphasis on public engagement within these institutions, this does allow them to comment on the 'research and society' issue outside of the STEM focus. Here a slightly different picture emerges. Certainly, in the baseline (McDaid, 2008) and follow-up (Stinton and Band, 2011) studies at the CUE East Beacon at UEA, the mixture of one-way communication and two-way dialogue understandings also emerges; a hint of change over time is offered by Stinton and Band's (2011) suggestion that these are more oriented towards dialogic objectives in their study than in McDaid's (2008) earlier study. Within the context of the PER Catalysts, Grand et al.'s (2015) small scale study offers a similar picture, identifying evocations of both more communicative (30%) and more dialogic or collaborative (19%) objectives. However, different understandings are also present, and these serve to illustrate the varied histories of the activities that have been brought together under the rubric of public engagement. For instance, a 'youth and community' researcher in Davies' (2013) work at the Beacon NE stated that the objective of public engagement is for her research to support particular disadvantaged social groups both directly and through policy.

Personal enjoyment and satisfaction

In the context of personal motivations for undertaking public engagement, two topics are common features in the literature. The issue of *career progression* – or *reward and recognition*, more broadly – is dealt with in its own section below and *personal satisfaction or enjoyment* is discussed here. Once again, the literature in this area is typically focused on scientists. Personal satisfaction and enjoyment is a common feature of discussions of scientists' stated motivations for undertaking public engagement (and its precursors). In Wellcome Trust (2000: 31) and BBSRC (2014: 5), 22% and 28% of respondents, respectively, identified personal satisfaction unprompted. In Royal Society (2006: 33), 63% of respondents agreed with the statement that public engagement is 'personally rewarding'. In Martín-Sampere et al.'s (2008: Spain) survey, scientists at a science fair cited personal enjoyment as a reason for participating. However, in Dunwoody et al.'s (2009) regression analysis, these intrinsic rewards were not significant.

In these quantitative studies it is typically not possible to identify exactly why researchers find public engagement personally rewarding. However, this theme is also present in the more qualitative analyses in which researchers' specific reasons can become apparent (Pearson et al., 1997; Squirrel, 2007; FreshMinds, 2008; Burchell et al., 2009; Burns and Squires, 2012; Wilkinson and Sardo, 2011; Wilkinson et al., 2011; Hussain and Moore, 2012; Johnson et al., 2013; Bultitude et al., 2013; Davies, 2013). In some cases, researchers'

personal satisfaction is related to the achievement of a particular objective in the context of the relationship between research and society, or institutional objectives. In others, the personal reward comes from a more intrinsic sense of fun and enjoyment of social situations.

That said, where it is possible to directly compare, personal satisfaction is typically subsidiary to the more instrumental motivations relating to relationships between research and society that were discussed above (Martín-Sampere et al., 2008: Spain), and this is a discernible pattern in most of the other materials cited here. The two significant exceptions to this are the studies that were carried out at the Hussain and Moore-UCL Beacon for Public Engagement (FreshMinds, 2008; Hussain and Moore, 2012). In both of these studies, personal enjoyment is reported to be a highly important experience and driver of public engagement by staff; *the most important* in the former study.

Institutional objectives

Very often, researchers reflect on the objectives of public engagement in terms of other university objectives. For instance, in McDaid's (2008) baseline study at the CUE East Beacon at UEA, public engagement was understood by many academics within the context of university objectives, such as: admissions, public relations, knowledge transfer/consultancy, widening participation and so on (also see similar themes in Squirrel, 2007; Burchell et al., 2009). Some researchers in Stinton and Band's (2011) follow-up study at CUE East understood public engagement to refer to activities that are undertaken locally in pursuit of general civic education.

5 Barriers and recent efforts to overcome them

This chapter addresses five key themes: ‘reward and recognition’ and ‘skills, confidence and training’ have long been recognised as important with respect to increasing levels of public engagement; recent experience in the context of the Beacons for Public Engagement programme suggests that when senior institutional support and dedicated resources are directed towards these issues, positive change can take place; however, the evaluations of the Beacons for Public Engagement do not facilitate easy identification of priority actions; researchers tend to support action in these areas, though with some caveats; in addition, professional stigma remains a potential challenge in the STEM disciplines.

Reward and recognition

The policy documents and empirical research in this domain often refer to the ‘barriers’ to public engagement. In addition, they also often attempt the trickier task of referring to the opposite of barriers. Here, a variety of terms is used, such as: benefits (e.g. Wellcome Trust, 2000), motivators (e.g. Poliakoff and Webb, 2007), incentives (e.g. Sheppard, 2007) and facilitators (e.g. Squirrel, 2007). In this section, I refer to factors that act as barriers to public engagement and factors that act as facilitators of public engagement. Examination of the literature reveals two central sets of factors. In this section, factors related to reward and recognition are discussed. In the next section, factors related to skills, confidence and training are examined.

In the policy domain, the need for systems of reward and recognition – by both institutions and funders – has long been identified as a key barrier to greater participation in public engagement and its precursors (Royal Society, 1985; House of Lords, 2000; Research Councils UK et al., 2010). With this in mind, the provision of such systems has often been identified as a facilitator of public engagement and the issue has gradually moved up the agenda. Having stressed the importance of what it refers to as public understanding of science, Royal Society (1985: 35) merely recommends that the Society set-up an annual prize. From 1987 to 2004, the science communication grants scheme run by the government-funded Committee on the Public Understanding of Science was an important incentive. Increasingly over this period: scientists were required to describe their proposed public understanding of science activities in scientific funding bids; dedicated funding for public engagement became more available; and public understanding and public engagement activities were incentivised – and, for some scientists, rewarded – through award schemes. The Science

and Society report mentions reward by funders and institutions (House of Lords, 2000), but there is little indication of the dramatic changes that were to come. Within ten years, the NCCPE and six Beacons for Public Engagement had been established with the development of systems for the reward and recognition for public engagement by academic institutions central to their remit. In the context of funding, the four UK funding bodies announced that public engagement would be rewarded through the new 'impact case study' section of the Research Excellence Framework (the mechanism through which government funding accrues to universities) (Lord Drayson, 2009); the funders of UK public research highlighted reward as central to their public engagement strategy (Research Councils UK et al., 2010); and, public engagement was emphasized in the Research Councils UK Pathways to impact framework.

The literature on scientists' views broadly suggests that this increased emphasis is well-placed, though not as conclusively as might be expected and with some important caveats. In some studies, it is not straightforward to distinguish between reward that is primarily institutionally-based (such as promotion criteria) and reward that is primarily funder-based (and, indeed, the two are related). In the earliest study in this review, around 75% of scientists agree with the notion that non-research work, such as communication or engagement is insufficiently rewarded (Dunwoody and Ryan, 1985: 32: US). In early qualitative work, Kyvik (2005: Norway) – referring to his own evidence from the early 1990s that was not available to this review – and Gascoigne and Metcalf (1997: Australia) offer the same overall conclusion. More recently, this theme is also broadly present in Squirrel (2007), FreshMinds (2008), McDaid (2008), Burchell et al. (2009) and Stinton and Band (2011), and it is increasingly complemented by researchers' assertion that public engagement *should* be rewarded to a greater extent (by both funders and employer institutions).

Reward by funders

Research on this focuses on the STEM disciplines. The Wellcome Trust (2000: 31) study of bioscientists and the Royal Society (2006: 33) study of scientists and engineers indicated that 32% and 38% respectively – perhaps more than might have been expected at this stage – agree that public engagement can be helpful in terms of career development. In addition, in Wellcome Trust (2000: 45), 25% of respondents agreed that 'communication' could be encouraged through the then Research Assessment Exercise and 65% agreed with the idea of broader incentives from funders. The authors of People, Science and Policy (PSP, 2009) were given access to a baseline survey that was carried out across the six Beacons for Public Engagement. This suggested that 42% of researchers thought that public engagement is helpful in this regard (see PSP, 2009: 12). As is often the case with surveys, it is not straightforward to discern the rationale behind the views expressed, but it is possible that the inclusion of public engagement as a

criterion in research bids was having an impact at this stage. Certainly, reward of this kind by funders was more prevalent than direct reward by institutions over this period, so this appears most likely. As further possible evidence of this, the Wellcome Trust study also indicates that 29% of respondents agreed that public engagement can attract funding. That said, Burchell et al. (2009) contains considerable qualitative evidence that scientists – while noting the increased significance of public engagement in funding proposals – also have ambiguous views about the extent to which this criterion is taken seriously by proposal reviewers and panels.

Reward by institutions

Within the context of inclusion in job descriptions, and appraisal and promotion criteria, the direct reward by employer institutions of researchers' public engagement activities is a more recent aspect of the public engagement agenda. The Beacons for Public Engagement baseline survey that was reported in PSP (2009: 10) suggests that public engagement was salient in only around 15% of cases in this context. In Burchell et al. (2009: 56), a scientist reports that public engagement activities are 'completely discounted' in promotion applications, while a researcher in Stinton and Band (2011: 24) reports that 'it still hinges on research'. Of course, this is a rapidly changing domain, but recent work in the context of the Beacons for Public Engagement suggests a highly varied picture in which different institutions – and even different departments within the same institution – appear to reward public engagement differently (FreshMinds, 2008; McDaid, 2008; Stinton and Band, 2011). In addition, this work suggests that researchers are often not aware when public engagement is a criterion.

In data that seems to contradict some of these messages, the extent to which researchers feel that their institution 'recognises and values' public engagement has been examined in four CROS surveys (Vitae-CROS, 2009: 33; 2011: 30; 2013: 20; 2015). These surveys suggest that the percentage of researchers who agree or strongly agree with this statement has increased from 41% in 2009, to 46% in 2011 and 53% in 2013, but fell slightly to 50% in 2015. Among senior researchers, this figure was 65% in 2013 and 63% in 2015 (Vitae-PIRLS, 2013: 22; 2015). The 2015 cross-tabulations of the CROS and PIRLS surveys of more junior and more senior researchers, respectively, that were commissioned from Vitae do not reveal any differences between the genders in this regard. However, they do suggest that agreement with this statement is particularly high in the arts and humanities (58% in CROS and 68% in PIRLS), compared to the other disciplines (around 50% in CROS and 62% in PIRLS).

Researchers' concerns

As has been suggested, researchers are often supportive of greater reward for public engagement. However, recent qualitative research in which researchers are able to discuss the nuances of their views reveals a number of concerns. For instance, researchers are concerned about how public engagement might be meaningfully measured and evaluated – particularly in ways that are able to discern quality, take account of the differing potential for public engagement of different research topics and individual researchers, and discern tangible outcomes (Squirrel, 2007; Burchell et al., 2009; Stinton and Band, 2011; Burns and Squires, 2012; Watermeyer, forthcoming b). Watermeyer (forthcoming b) also reports that researchers who are committed to public engagement are often scathing about the very small amounts that are awarded for public engagement, often not covering any staff time, and the extent to which this forces their departments to lose money in order to support public engagement. Research also reveals concerns about the potential for a 'tick box', coercive or over-managed culture in which researchers undertake public engagement for the wrong reasons or are forced to participate (Burchell et al. 2009; Watermeyer, forthcoming b). In the broader context of research 'impact', Watermeyer's (2014a: 367) recent research also identifies concerns about a 'tick box' culture in which researchers – as one of his interviewees puts it – 'play the impact card'.

Skills, confidence and training

In a variety of forms, research into researchers' attitudes towards communication and engagement activities has often noted relationships between a number of factors – the possession of appropriate skills, previous experience and previous training – and the confidence to undertake such activities, and with the propensity to participate (Gascoigne and Metcalf, 1997; Wellcome Trust, 2000: 22, 35, 39; Royal Society, 2005: 14; Ruth et al., 2005: US; Poliakoff and Webb, 2007; Duensing et al. 2008; FreshMinds, 2008; Dunwoody et al., 2009; Burchell et al., 2009; Vitae-PIRLS, 2011; 2013; Burns and Squires 2012; Dudo, 2012: US; Bultitude et al., 2013; BBSRC, 2014)²¹. Thus, the literature also often identifies the *lack* of these as barriers to greater researcher participation in public engagement. This body of work also often suggests that greater confidence is also a characteristic of more senior and male researchers, and a greater participation in training among men has also been noted in one study (Crettaz von Roten, 2011: Switzerland). Somewhat curiously, perhaps, the literature suggests that relatively few researchers have undertaken training in communication and engagement, and – at the same time – that levels of confidence are relatively high. This might suggest that public engagement is an activity that is typically learned through experience or from peers. Within this

21 Ruth et al. (2005) and Dudo (2012) employ inferential statistics.

context, it would be helpful to comment further on: the extent of the training that researchers have undertaken, the extent of confidence among researchers and the main types of training that are being offered contemporarily.

Training

Establishment of these relationships signals that the funders of research have been correct to recommend and give attention to the provision of public engagement training, from Royal Society (1985) and Wolfendale (1995) right through to the Concordat (Research Councils UK et al., 2010), the and final reports/evaluations of the Beacons for Public Engagement, and the ongoing work of the NCCPE. While earlier materials speak merely of training, in more recent materials (such as the Beacons for Public Engagement reports and evaluations), these kinds of activities are also framed in terms of: mentoring, learning, skills development, continuous professional development, knowledge communities and so on.

It is not easy to comment on the extent of either the provision or uptake of communication and engagement training, and change over time is especially difficult to clarify. Certainly, the idea of training in public engagement tends to be supported and requested by researchers; examples of training being actively rejected are rare (see Pearson et al., 1997). Wellcome Trust (2000: 46) cites figures such as 16% for the uptake of training in communicating in general and 10% for work with the media; Royal Society (2006: 34) suggests 27% for all kinds of communication training and Ruth et al. (2005: 137) suggest 34% for media training; Vitae (2013: 23) suggests 19%. Even in the context of a small group (60) of neuroscientists at a public festival, Bultitude et al.'s (2013) work suggests only 52% previous participation in training. This impression of training for public engagement as a relatively minority pursuit also emerges from Dudo (2012: US) and some of the more qualitative work, such as Squirrel (2007) and Burchell et al. (2009). The cross-tabulations that were commissioned from Vitae-CROS (2015) indicate slightly greater participation in and desire for training in public engagement among women (25% and 51% respectively) than among men (18% and 49%). The Vitae-CROS (2015) cross-tabulations also suggest very high participation in and desire for training in the arts and humanities (28% and 52% respectively) than in the STEM and social science disciplines (around 20% and 50%).

The evaluations and reports from the Beacons for Public Engagement offer a very mixed level of depth when commenting on this issue. However, all of the Beacons for Public Engagement indicate increases in levels of demand and provision (Chapman and Mancini, 2011; Stinton and Band, 2011; Edinburgh Beltane Beacon, 2012; EKOS-Manchester Beacon, 2012; Hussain and Moore-UCL Beacon, 2012; Beacon NE, 2013; Beacon for Wales, 2013; CUE East,

2013; Moore, 2014). These documents indicate a variety of topics and formats for these activities.

Engagement methods

- Methods and techniques related to engaging particular audiences;
- Methods and techniques relating to particular activities;
- Communication and 'traditional' media;
- Social and digital media;
- Participatory research methods, co-enquiry and citizen science (sometimes offered for researchers and community groups jointly).

Broader issues

- Introduction and background to public engagement;
- Institutional systems and structures to support public engagement;
- Evaluation tools and techniques;
- 'Impact' plans;
- Applying for funding.

Formats

- Formal training events;
- Informal advice and support;
- Mentoring and ambassador schemes;
- Booklets and handbooks;
- Learning circles or communities;
- Videos on websites.

The Beacons for Public Engagement reports and evaluations offer a mixed-bag in terms of understanding the participation in this regard. Hussain and Moore-UCL Beacon (2012: 11) indicates that training and mentoring was provided to more than 2000 staff and students from UCL and elsewhere, but it is not possible to contextualize this as a proportion or in terms of change. The same is true of

Beacon for Wales' (2013: 10) comment that almost 300 staff received training or advice. Among the 26 researchers interviewed in Stinton and Band's (2011: 43) evaluation study at the CUE East Beacon at UEA, none had undertaken engagement training during the Beacon period, though six thought they had before the Beacon was established.

It is interesting to consider the factors that appear to constrain the uptake of public engagement training and related activities. The aforementioned issues of time and competing higher priorities have been cited by researchers as reasons for not undertaking training in communication and public engagement (Stinton and Band, 2011). In response to this challenge, in some comments by researchers and in the programmes of the Beacons for Public Engagement, the idea of locally-based, short – or bite-sized – training is identified as preferable to far-flung and long courses. Some materials raise concerns about the extent to which researchers are aware of the training that is available. For instance, in Stinton and Band's (2011: 43-4) research, 20 of the 26 interviewees were not aware of the Beacon's public engagement training provision. It is also not possible to say much about the extent to which researchers are satisfied with their public engagement training provision. PIRLS (2011: 26) suggests a 55% satisfaction rate among senior researchers, with non-satisfaction at 37%.

Confidence

As indicated earlier, the literature often identifies a relationship between confidence and propensity to participate. The idea of confidence is expressed in a number of ways in the literature. For example, in the Wellcome Trust (2000: 39) survey of bioscientists, 76% declared themselves "very" or "fairly" 'well-equipped' for public communication. In Royal Society (2006), this is placed at 51%. In the FreshMinds (2008: 34) pre-Beacon study at UCL, around 80% of respondents claimed both the confidence and the skills – 'to some extent' or 'a great deal' – to conduct public engagement. In the 2011 Principal Investigator and Research Leader Survey (PIRLS), 47% of respondents expressed themselves as confident, while the same percentage said they wished to be more confident (Vitae, 2011:26). In Kreimer et al.'s. (2011: Argentina) study, 50% of scientists said that they feel qualified to communicate with the public.

Professional stigma

The notion of a risk of professional stigma on the basis of involvement in public engagement features in a number of items, often as a relatively minor concern (Royal Society, 1985; Royal Society, 2005; 2006; Poliakoff and Webb, 2007; McDaid, 2008; Burchell et al., 2009). In this context, the charges are multiple. Sometimes researchers feel themselves to be criticised for a perceived

inappropriate preference for the limelight and corresponding neglect of their research. For instance, in Burchell et al.'s (2009: 61) work on this topic, one interviewee (a highly successful scientist) invoked the pejorative appellation 'media tart' as a slur that others might apply to him on the basis of his public engagement work. In other instances, inadequacy as a researcher is a perceived judgement on those who undertake a lot of public engagement. For instance, more junior researchers in Royal Society (2005: 8) stated that other researchers might say, 'He is doing that because he could not build a good enough research career' or feel that public engagement is 'second best if you can't make it in the academic system'.

Within this context, it is interesting to note the aforementioned relationships between seniority and participation in communication and engagement activities; clearly, a strong track record in research and involvement in public engagement is not incompatible in many cases. However, this does appear to be a lingering if relatively minor concern.

The risks associated with media work

Although work with the traditional media is not included in contemporary official definitions, it does loom large in the understandings of researchers, especially scientists. The importance of – and challenges relating to – working with journalists and the media is a theme that is present across much of the literature, with many items focusing specifically on this issue within the context of the sciences. Materials that focus on the attitudes and experiences of scientists (and, in a few cases, other researchers) with respect to the media include: Dunwoody and Ryan (1985), Gascoigne and Metcalfe (1997), Gunter et al., (1999), Wellcome Trust, (2000), Kyvik (2005), Royal Society (2005), Ruth et al. (2005), Burchell et al. (2009), Dudo (2012), Porter et al. (2012), Tøsse (2013), Pew Research Center (2015), and Besley's (2014) recent work in the context of digital media. In addition, Tydén and Nordfors (2000), and Miller et al. (2009) comment on media and communication training programmes for scientists.

Summarising this inevitably varied literature is not straightforward, but – taken as a piece – it suggests that scientists understand the media to be a significant factor in determining attitudes among the public; indeed the blame for perceived public skepticism about science is often laid at the door of the media. On this basis, communicating with journalists and the media is often understood as particularly worthwhile among the various public engagement activities on offer (the most worthwhile, according to BBSRC, 2014: 7). At the same time, scientists also often refer to the disincentives that were discussed above in the context of media work. However, scientists also consistently express a range of specific misgivings about working with the media. Some of these accrue from the ways in which the

media works, for instance the fear that journalists will oversimplify, misrepresent or sensationalise research is commonplace. Other concerns are related to the personal risks that accrue from the very high levels of exposure that individual researchers can experience through media work. This is a particular concern in the context of animal research.

6 The views of enablers and vice-chancellors

The key points in this chapter are: although the public engagement agenda has led to the emergence of a range of novel professional support roles, the views of these 'enablers' has not been examined; although the views of senior academic managers also remain under-examined, there is evidence that the ambiguity and uncertainty that is expressed by researchers is also experienced by senior managers.

The views of 'enablers'

As has been discussed earlier, the emergence of the public understanding of science, science communication, public engagement and 'impact' agendas has led to the emergence of new categories of university support staff whose role is to facilitate and support the activities of researchers. Anecdotal evidence suggests that these so-called 'enablers' inhabit a range of institutional homes: sometimes in academic departments, sometimes in central departments (such as research support, HR, media and public relations, marketing, training and development and so on). Correspondingly, these professionals also appear to have a wide range of backgrounds, often including research, and funding for their posts comes from a wide range of sources. Considering the institutional objectives to further professionalise and institutionalise public engagement, this is clearly an important – and, perhaps, increasingly important – group. However, although research has investigated the perspectives of science communication professionals (Treise and Weingold, 2002: US), more recent research on public engagement 'enablers' in the context of higher education institutions themselves appears to be a gap in the literature (and this will begin to be addressed by the 2015 'Factors affecting public engagement by researchers' research).

The views of vice-chancellors

As has been discussed, the literature highlights a relationship between seniority and participation in public engagement, and some work indicates that there is support for the public engagement agenda in some high level quarters (e.g. Burchell et al., 2009). However, there is little work that is specifically on the views with respect to public engagement of vice-chancellors and other very senior academics. This is important, of course, since very senior staff with high levels of managerial responsibility are highly influential within higher education institutions.

Watermeyer (2011) presents an analysis of 24 interviews with 'senior academics with managerial responsibility' (p386): 8 vice-chancellors of teaching-focused institutions, the principal of a national conservatoire for the performing arts and 15 heads of school at one research-intensive institution (p391). Overall, in keeping with the broader picture, Watermeyer describes a terrain that is characterised by ambiguity, uncertainty and anxiety. Watermeyer (p391) reports that recruitment to his study was highly challenging, partly for practical reasons (such as busy diaries), but also due to refusal to participate on the basis of 'resistance to the idea of engagement and even discussion around it'. More specifically, the views of the senior academics in this study, seem to resonate with many of the issues described earlier, such as: ambiguity about the term itself; anxiety and ambiguity about the true nature of the official objectives for public engagement and the lack of evidence for its value; anxiety about public engagement within the context of a research-driven profession; and concerns about skills. That said, Watermeyer's study also reflects broader growing acknowledgement of a role for public engagement.

7 Discussion

As well as summarising the key themes in the review, this chapter also more speculatively contributes to four discussions that can be taken forward by the Consortium if appropriate: the broader context within which levels of public engagement by researchers might be assessed; the potential for segmentation in future public engagement strategies, particularly on the basis of academic discipline; the challenge relating to media work – an activity that is eschewed in some contemporary definitions of public engagement, but remains central to many researchers’ understandings; and, the need for both consolidated evaluation of public engagement programmes (such as the Beacons for Public Engagement and the PER Catalysts), and encouraging evaluation as an intergral part of public engagement.

On behalf of the UK funders of public research, this literature review has been carried out within the context of new quantitative and qualitative research that is designed to understand recent change in the domain of public engagement. This new research aims to understand public engagement from the particular perspective of researchers and public engagement ‘enablers’ (professional support staff). One of the objectives of the review is to provide a context for this new research by synthesising existing research that addresses the views and experience of researchers with respect to public engagement (and its precursors). An additional objective is to summarise the policy developments that inform change in the sector over the past thirty years. The purpose of the new research and the literature review together is to provide evidence for future planning and policy by the UK funders of public research in the context of public engagement.

The available literature – which dates from 1985 to 2015 – reveals a somewhat unclear and confused picture. To a considerable extent, this is due to two inter-related factors. First, the ways in which the *topic* of the research is framed (public engagement, science communication, outreach and so on) is highly varied. Second, there is considerable inconsistency with respect to the *disciplinary populations* that are examined in the research (researchers, scientists and engineers, scientific sub-disciplines and so on). Added to this, the longitudinal quantitative research that is available often varies over time in terms of its content and is based upon convenience samples. To a considerable extent, the new research should address these challenges and has the potential to form the baseline for a new longitudinal quantitative and qualitative dataset. The aim in this discussion is to revisit the key findings of the literature review and to speculate on actions that might be taken. Despite the challenges associated with the materials, a number of conclusions can be drawn on the basis of the most

recent literature. In particular, four are discussed below: judging the extent of public engagement; the potential for segmentation in future strategies; the place of media work in public engagement; and, the need for evaluation.

The extent of public engagement

Recent large scale survey work in the UK – while flawed in some respects – indicates that the extent of participation in public engagement by researchers is either stable (at around 40% of researchers) or perhaps increasing marginally; certainly, the evidence does not point to a decline. It will not be straightforward to directly compare the new research with previous studies. However, results about the extent of public engagement in the UK must be judged within the context of three key issues:

- Research demonstrates that higher education institutions are traditionally slow to change (Harris et al. 2003).
- Recent developments in the context of public engagement have taken place against a challenging backdrop of reduced public funding for research in particular and for universities in general. This serves to increase competition for research funding and therefore focus researchers' efforts even more firmly in that area, and it serves to increase the workloads of academics.
- Finally, it should always be borne in mind that – although many researchers are highly committed to public engagement – there is a sense in which the public engagement agenda represents a fundamental, externally-driven redrawing of the academic job description.

Within these contexts, the maintenance of levels of public engagement might be judged as a success in itself.

Segmentation

In support of the further development of the public engagement agenda, a key contribution of this review – as well as the new research – might lie in the extent to which it facilitates segmentation of researchers according to a variety of criteria. For instance, this might inform differentiation within future broad-based strategies, and may also imply different objectives and strategies in different research councils and learned academies. Importantly, the section of the review that focuses on the various genealogies of the public engagement agenda reveals the diverse starting points of different disciplines. To grossly oversimplify: communication and education in the STEM disciplines; public participation, exhibition and performance in the arts and humanities; and public

participation and social empowerment in the social sciences. This is an important point because these differing histories appear to shape the contemporary public engagement landscape. One important issue – that is hinted at in the existing literature and can be examined in the new research – is that these histories are likely to frame the dominant contemporary understandings of public engagement that prevail in different disciplines. More specifically, it is interesting to note that the STEM disciplines sometimes appear as an outlier compared to one or more of the other main disciplinary categories. For instance, there is recent and longer term evidence that the extent of public engagement activities that are undertaken by researchers appears to be considerably lower in the STEM disciplines than in the arts, humanities and social sciences. In addition, there is recent evidence that the uptake of training for public engagement is lower in the STEM subjects.

Similarly, the literature contains indications that public engagement itself as well as the uptake of training in public engagement might be slightly more prevalent among female researchers (though the reverse is the case in the more historical context of media work in the sciences). In addition, the literature contains historical evidence, typically from the sciences, that more public engagement is undertaken by more senior researchers. Both of these issues can be re-examined in the context of the findings from the new research and might provide evidence for differentiated actions in future policy and planning.

Media work

As has been discussed, the Concordat for Engaging the Public with Research conspicuously omits media work from the list of example activities that it cites as part of public engagement (Research Councils UK et al. 2010); this is, perhaps, an understandable move in a field that was keen to emphasise the two-way forms of engagement that remain relatively novel in some academic disciplines. Within this context, a notable feature of the recent literature is the focus on media work, for example in some of the evaluations and reports from the Beacons for Public Engagement. Importantly, this work examines public engagement across disciplines and is not focused on the scientific domains where an emphasis on media work might be expected. There would appear to be a strategic question here for the Consortium. At the risk of appearing a little dogmatic and detached from practice, should media work remain outside of 'official' definitions, or – at the risk of under-emphasising more interactive forms of engagement – should the plurality of 'official' definitions be increased to allow a place for media work?

Evaluation

As was discussed earlier, the evaluations of the Beacons for Public Engagement are typically positive. In particular, they indicate that – when funding and senior commitment are present – innovative activities, processes and structures emerge and learning takes place. At the same time, the value of the evaluations is somewhat limited in four key ways:

- Each evaluation was undertaken by a different evaluator; consequently, the methods of evaluation vary. This means that evaluation across and between the Beacons for Public Engagement is not straightforward.
- Some of the evaluations do not include a baseline against which change can be evaluated.
- Some of the evaluations were carried out by a unit within the same institution as the Beacon itself, which is to say that they are semi-independent but not fully independent.
- Some of the evaluations appear to focus on summative or end-of-project evaluation only, overlooking the potential of formative and iterative evaluation during the course of the project.

At the more micro-scale, there is evidence in the literature that the evaluation of individual public engagement activities remains a minority pursuit, and often relies upon very informal and anecdotal evidence. As would be expected, guidance on evaluation is already a feature of the public engagement offerings of many of the funders of UK public research (for instance, see Research Councils UK et al., 2011b). However, given the increasingly central place that evaluation holds in contemporary policy and practice, the limited evidence available suggests that this might be worthy of increased attention in future strategies.

Closing comment

When considering the findings of this review, it is obviously important to remember that the contemporary evidence base will grow rapidly over the coming months. In particular, the literature that is reviewed here will be complemented by new information from: the 2015 'Factors affecting public engagement by researchers' research that accompanies this review and the evaluations from the PER Catalysts.

8 Bibliography

Andrews, E., Weaver, A., Hanley, D., Shamatha, J., & Melton, G. (2005). Scientists and public outreach: participation, motivations, and impediments. *Journal of Geoscience Education*, 53(3), 281.

The BA (2002) Science in society: advice to the Office of Science and Technology from the BA.

The BA (Roland Jackson, Fiona Barbagallo and Helen Haste) (2005) Strengths of public dialogue on science-related issues, *Critical Review of International Social and Political Philosophy*, 8(3), pp. 349–58.

Bauer, M. & Jensen, P. (2011). The mobilization of scientists for public engagement. *Public Understanding of Science*, 20(1), 3.

Bauer, M., Allum, N. & Miller, S. (2007). What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda. *Public Understanding of Science*, 16 (1). pp. 79–95.

BBSRC (2014). *Public engagement and science communication survey*, BBSRC External Communications Unit. <http://www.bbsrc.ac.uk/web/FILES/Reviews/pe-and-science-comm-report.pdf>

Beacon for Wales (2013). *Beacon for Wales Final Report*. <http://www.publicengagement.ac.uk/resources>

Beacon North East (2012). *re:action: reflections on public engagement in higher education*. <http://www.publicengagement.ac.uk/resources>

Bentley, P. & Kyvik, S. (2011) Academic staff and public communication: A survey of popular science publishing across 13 countries. *Public Understanding of Science*, 20(1), 48–63.

Besley, J. (2014). What do scientists think about the public and does it matter to their online engagement? *Science and Public Policy*, scu042.

Besley, J., Oh, S. & Nisbet, M. (2013). Predicting scientists' participation in public life. *Public Understanding of Science*, 22(8) 971–987.

BIS (2009) Science and society in the UK.

BIS (2012) Draft vision for Science and Society. <http://webarchive.nationalarchives.gov.uk/20121205091100/http://scienceandsociety.bis.gov.uk/blog/2012/10/12/x/>

BIS (2014) UK Charter for Science and Society. <https://scienceandsociety.blog.gov.uk/uk-charter-for-society/>

Boyatzis, R. (1998). *Transforming qualitative information: Thematic analysis and code development*. Thousand Oaks, California: Sage.

Bultitude, K., Lock, S. & Hutchinson, L. (2012). *Festival of Neuroscience Research Report*. UCL.

Burchell, K., Franklin, S. & Holden, K. (2009). *Public Culture as Professional Science*. Final report of the ScoPE project. http://eprints.kingston.ac.uk/20016/1/ScoPE_report_-_09_10_09_FINAL.pdf

Burns, D. & Squires, H. (2012). *Embedding public engagement in higher education: Final report of the national action research programme*. National co-ordinating centre for public engagement. http://www.publicengagement.ac.uk/sites/default/files/publication/action_research_report_0.pdf

Cabinet Office (1993). *Realising Our Potential: A Strategy for Science, Engineering and Technology*.

Chapman, J. & Mancini, A. (2011). Final evaluation of the Beacon North East Programme).

Collini, S. (2009). Impact on humanities: researchers must take a stand now or be judged and rewarded as salesmen. *The Times Literary Supplement*, 13 November. <http://www.sauvonsluniversite.com/spip.php?article3150>

Council for Science and Technology (2005) *Policy through dialogue: informing policies based on science and technology*. <http://webarchive.nationalarchives.gov.uk/20100714131339/http://www.cst.gov.uk/cst/reports/files/policy-through-dialogue/report.pdf>

Crettaz von Roten, F. (2011). Gender differences in scientists' public outreach and engagement activities. *Science Communication*, 33(1) 52–75.

CUE East (2013). *Final report for funders: CUE East Beacon for Public Engagement 2008-2012*. http://www.publicengagement.ac.uk/sites/default/files/publication/cue_east_uea_final_report.pdf

Davies, S. (2013). Constituting public engagement: Meanings and genealogies

of PEST in two UK studies. *Science Communication*, 35(6), 687–707.

Department of Innovation, Universities and Skills (DIUS) (2008). *A vision for Science and Society: a consultation on developing a new strategy for the UK*. http://webarchive.nationalarchives.gov.uk/20120708131021/http://interactive.bis.gov.uk/scienceandsociety/files/A_Vision_for_Science_and_Society.pdf

(Lord) Drayson (2009) Drayson says REF will give points for public outreach, *Times Higher Education*, 9 July 2009. <http://www.timeshighereducation.co.uk/story.asp?sectioncode=26&storycode=407326&c=1>

Dudo, A. (2012). Toward a model of scientists' public communication activity: the case of biomedical researchers. *Science Communication*, 35(4) 476–501.

Duensing, S., King, H. & Dillon, J. (2008). *Royal Society Summer Science Exhibition Study: Excerpts of key findings and recommendations*. KCL.

Dunwoody, S. & Ryan, M. (1985). Scientific Barriers to the Popularization of Science in the Mass Media. *Journal of Communication*, 35: Issue 1, 26–42. <http://onlinelibrary.wiley.com/doi/10.1111/j.1460-2466.1985.tb01882.x/abstract>

Dunwoody, S., Brossard, D., & Dudo, A. (2009). Socialization or rewards? Predicting US scientist-media interactions. *Journalism & Mass Communication Quarterly*, 86(2), 299–314.

Edinburgh Beltane Beacon for Public Engagement (2012). *Edinburgh Beltane Beacon for Public Engagement: final report*. <http://www.publicengagement.ac.uk/resources>

Ekos-Manchester Beacon (2012). *Final report of the Manchester Beacon for Public Engagement*. Report for Manchester Beacon Partners, January 2012. <http://www.publicengagement.ac.uk/resources>.

European Commission (2015) Responsible Research and Innovation. <http://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation>

Franklin, S. (ed.) (2010). *The impact of impact: workshop report* (3 September, 2010, London School of Economics and Political Science). <http://lse-impact.blogspot.co.uk/>

Fresh Minds (2008). *Establishing a baseline for public engagement: guiding your strategy*. Fresh Minds for UCL. <http://www.ucl.ac.uk/public-engagement/documents/evaluatereports/Baselinesurvey>

Gascoigne, T. & Metcalfe, J. (1997). Incentives and Impediments to Scientists Communicating Through the Media. *Science Communication*, 18: 265–82.

Goodson, L. & Phillimore, J. (2012). Community research: opportunities and challenges, in L. Goodson & J. Phillimore (eds.) *Community Research for participation: From theory to method*. Policy Press.

Grand, A., Davies, G., Holliman, R. & Adams, A. (2015). Mapping Public Engagement with Research in a UK University. *PLoS ONE*, 10(4) pp.1–19.

Gregory, J. & Miller, S. (1998) *Science in public: communication, culture and credibility*, Plenum, New York.

Gunter, B., Kinderlerer, J. & Beyleveld, D. (1999). The Media and Public Understanding of Biotechnology A Survey of Scientists and Journalists. *Science Communication*, 20(4), 373-394.

Harris, D., DeRosa, D., Liu, P. & Hash, R. (2003). Facilitating academic institutional change: Redefining scholarship. *Family Medicine-Kansas City*, 35(3), 187–194.

Higher Education Funding Council for England (HEFCE) (2011). *Research Excellence Framework 2014: Assessment framework and guidance on submissions*, July 2011. <http://www.ref.ac.uk/pubs/2011-02/>

HEFCE (2015) Higher education-business and community interaction survey (HE-BCI), <http://www.hefce.ac.uk/kess/hebci/>.

HM Treasury et al. (2004) *Science and innovation investment framework 2004-2014*, HMSO, London. http://webarchive.nationalarchives.gov.uk/+http://www.hm-treasury.gov.uk/spending_sr04_science.htm

House of Lords, Select Committee on Science and Technology (2000). *Third Report: Science and Society*. <http://www.publications.parliament.uk/pa/ld199900/ldselect/ldscitech/38/3801.htm>

Hughes, H., Kitson, M. & Probert, J. (2011). *Hidden Connections: Knowledge exchange between the arts and humanities and the private, public and third sectors*. AHRC and Centre for Business Research. <http://www.ahrc.ac.uk/News-and-Events/Publications/Documents/Hidden-Connections.pdf>

Hussain, R. & Moore, G.–UCL Beacon (2012). *UCL Beacon for public engagement: final report*. UCL Public Engagement Unit. <http://www.ucl.ac.uk/public-engagement/evaluation/reports/BPEReport>

Illingworth, S., Redfern, J., Millington, S. and Gray, S (in review) What's in a Name? Exploring the Nomenclature of Science Communication in the UK, <http://f1000research.com/articles/4-409/v1#reflist>.

Irwin, A. (2006). The politics of talk: coming to terms with the 'new' scientific governance, *Social Studies of Science*, 36(2): 299–320.

Israel, B. Eng, E., Schulz, A. & Parker, E. (2005). *Methods in Conducting Community-Based Participatory Research for Health*, San Francisco, CA: Jossey-Bass.

Jensen, P. (2011). A statistical picture of polarization activities and their evolutions in France. *Public Understanding of Science*, 20(1), 26–36.

Jensen, P., Rouquier, J. , Kreimer, P., & Croissant, Y. (2008). Scientists who engage with society perform better academically. *Science and public policy*, 35(7), 527–541.

Johnson, D., Ecklund, E. & Lincoln, A. (2013). Narratives of science outreach in elite contexts of academic science. *Science Communication*, 36(1), 81-105.

King's College London and Digital Science (2015). *The nature, scale and beneficiaries of research impact: An initial analysis of Research Excellence Framework (REF) 2014 impact case studies*. **Research Report 2015/01**. <http://www.kcl.ac.uk/sspp/policy-institute/publications/Analysis-of-REF-impact.pdf>.

Kreimer, P., Levin, L. & Jensen, P. (2011). Popularization by Argentine researchers: the activities and motivations of CONICET scientists. *Public Understanding of Science*, 20(1), 37–47.

Kyvik, S. (2005). Popular science publishing and contributions to public discourse among university faculty. *Science communication*, 26(3), 288–311.

Levitt, R., Celia, C., Diepeveen, S., Ní Chonail, Rabinovich, L. & Tiessen, J (2010). Assessing the impacts of arts and humanities research at University of Cambridge. RAND Corporation. http://www.rand.org/pubs/technical_reports/TR816.html

Martín-Sempere, M. J., Garzón-García, B., & Rey-Rocha, J. (2008). Scientists' motivation to communicate science and technology to the public: surveying participants at the Madrid Science Fair. *Public Understanding of Science*, 17, 349–367.

McDaid, L. (2008). A qualitative baseline report on the perceptions of public engagement in University of East Anglia academic staff. The Research Centre, CCN, Norwich. http://www.uea.ac.uk/polopoly_fs/1.134441!Baseline%20research%20report.pdf

McKibbin, R. (2010). Good for business, *London Review of Books*, 25 February, pp.9–10. <http://www.lrb.co.uk/v32/n04/ross-mckibbin/good-for-business>

Miller, J. (2004) Public understanding of, and attitudes toward, scientific research: what we know and what we need to know, *Public Understanding of Science*, 13(3): 275–94.

Miller, S., Fahy, D & The ESCOnet Team (2009). Can science communication workshops train scientists for reflexive public engagement? The ESCOnet experience. *Science Communication*, 31(1), 116–126.

Minkler, M. & Wallerstein, N. (eds) (2003). *Community Based Participatory Research for Health*, San Francisco, CA: Jossey-Bass

Minkler, M. & Wallerstein, N. (eds) (2008). *Community Based Participatory Research for Health: From Process to Outcome*, San Francisco, CA: Jossey-Bass.

Moore, G. (2014). *The Landscape of Public Engagement at UCL*.

National Co-ordination Centre for Public Engagement (NCCPE) (2015). <http://www.publicengagement.ac.uk/>

Neresini, F. & Bucchi, M. (2011). Which indicators for the new public engagement activities? An exploratory study of European research institutions. *Public Understanding of Science*, 20(1) 64–79.

Office of Science and Technology (2004). *The government's approach to public dialogue on science and technology*, December.

Office of Science and Innovation (2006). *The government's approach to public dialogue on emerging technologies*, September.

Owen, R., Macnaghten, P. & Stilgoe, J. (2012). Responsible research and innovation: From science in society to science for society, with society, *Science and Public Policy*, 39 (6): 751–760.

Parry, S., Faulkner, W., Cunningham-Burley, S., & Marks, N. J. (2012). Heterogeneous agendas around public engagement in stem cell research: The case for maintaining plasticity. *Science and Technology Studies*, Vol. 25 (2012) No. 2, 61–80.

Pearson, G., Pringle, S. & Thomas, J. (1997). Scientists and the public understanding of science. *Public Understanding of Science*, 6(3), 279–289.

People, Science and Policy (2009). *Reward and Recognition of Public*

Engagement. Report for the Science for All Expert Group. <http://webarchive.nationalarchives.gov.uk/20120708131021/http://interactive.bis.gov.uk/scienceandsociety/site/all/files/2010/02/Reward-and-recognition-FINAL1.pdf>

Pew Research Center (2015). How Scientists Engage the Public. <http://www.pewinternet.org/2015/02/15/how-scientists-engage-public/>

Poliakoff, E. & Webb, T. (2007). What factors predict scientists' intentions to participate in public engagement of science activities? *Science communication*, 29(2), 242–263.

Porter, J., Williams, C., Wainwright, S. & Cribb, A. (2012). On being a (modern) scientist: risks of public engagement in the UK interspecies embryo debate. *New genetics and society*, 31(4), 408–423.

POST (2002). *Public dialogue on science and technology*, Postnote 189, November. <http://researchbriefings.files.parliament.uk/documents/POST-PN-189/POST-PN-189.pdf>

POST (2006). *Debating science*, Postnote 260, March. <http://researchbriefings.files.parliament.uk/documents/POST-PN-260/POST-PN-260.pdf>

Reason, P. & Bradbury, H. (2001). *Handbook of Action Research: Participative Inquiry and Practice*, Thousand Oaks, CA: Sage.

Research Councils UK (2011a). Public Engagement with Research: CATALYSTS. Call for Proposals. <http://pure.qub.ac.uk/portal/files/5410295/PERCatalystCallforProposals.pdf>

Research Councils UK (2011b). Evaluation: Practical Guidelines - A guide for evaluating public engagement activities. <http://www.rcuk.ac.uk/RCUK-prod/assets/documents/publications/evaluationguide.pdf>

Research Councils UK (2015a). Catalyst Seed Fund 2015. <http://www.rcuk.ac.uk/RCUK-prod/assets/documents/scisoc/RCUKcatalystseedfundguidance.pdf>

Research Councils UK (2015b). Pathways to Impact, <http://www.rcuk.ac.uk/innovation/impacts/>

Research Councils UK et al. (2010). Concordat for engaging the public with research: a set of principles drawn up by the funders of research in the UK. <http://www.rcuk.ac.uk/per/Pages/Concordat.aspx>

Royal Society (1985). *The Public Understanding of Science*. Royal Society,

London. <https://royalsociety.org/policy/publications/1985/public-understanding-science/>

Royal Society (2001). *Science and society*, Royal Society, London.

Royal Society (2004). Response to Treasury's consultation Science and Innovation: working towards a ten-year investment framework, Royal Society, London. https://royalsociety.org/~media/Royal_Society_Content/policy/publications/2004/9708.pdf

Royal Society (2005). Factors affecting science communication. Report on qualitative research prepared for the Royal Society by People, Science & Policy Ltd. https://royalsociety.org/~media/Royal_Society_Content/policy/publications/2006/2012-07-24-Science-Communication-Qualitative.pdf

Royal Society (2006). Science Communication: Survey of factors affecting science communication by scientists and engineers. https://royalsociety.org/~media/Royal_Society_Content/policy/publications/2006/1111111395.pdf

Royal Society and Royal Academy of Engineering (2004) *Nanoscience and nanotechnologies: opportunities and uncertainties*. <http://www.nanotec.org.uk/finalReport.htm>

Ruth, A., Lundy, L., Telg, R., & Irani, T. (2005). Trying to Relate Media Relations Training Needs of Agricultural Scientists. *Science Communication*, 27(1), 127–145.

Sciencewise (2015) Sciencewise – the UK's national centre for public dialogue in policy making involving science and technology issues, <http://www.sciencewise-erc.org.uk/>

Sheppard, C. (2007). *Scientists' understandings of, attitudes to and experiences of public engagement in nanotechnology: a qualitative study*. MSc Science Communication dissertation, Imperial College.

Smith, S., Ward, V. and House, A. (2011). 'Impact' in the proposals for the UK's Research Excellence Framework: Shifting the boundaries of academic autonomy, *Research Policy*, 40 (10): 1369–1379.

Squirrel, G. (2007). *Science and Engineering Engagement: A snapshot of some engagement activities and the context of engagement*. SEARCH report.

Stahl, C. (2013). Responsible research and innovation: The role of privacy in an emerging framework, *Science and Public Policy* (2013) 40 (6): 708–716.

Stilgoe, J., Lock, S., & Wilsdon, J. (2014). Why should we promote public engagement with science? *Public Understanding of Science*, 23 (1). pp. 4–15.

Stinton, J. & Band, H. (2011). *A repeated qualitative baseline report on the perceptions of public engagement in University of East Anglia academic staff*, Report No. RS7412, The Research Centre, CCN, Norwich.

Torres-Albero, C., Fernández-Esquinas, M., Rey-Rocha, J. & Martín-Sempere, M. (2011). Dissemination practices in the Spanish research system: scientists trapped in a golden cage. *Public Understanding of Science*, 20(1), 12–25.

Tøsse, S. (2013). Aiming for social or political robustness? Media strategies among climate scientists. *Science Communication*, 35(1), 32–55.

Treise, D. & Weigold, M. (2002). Advancing Science Communication: A Survey of Science Communicators. *Science Communication*, 23(3), 310–322.

Tydén, T. & Nordfors, D. (2000). Report: INFOPAC—Researchers learn research dissemination by doing. *Science Communication*, 21(3), 296–308.

UK Government (2005). *Council for Science and Technology Report, Policy through dialogue, published March 2005, Government response*, October. <http://webarchive.nationalarchives.gov.uk/20130705054945/http://www.bis.gov.uk/assets/cst/docs/files/whats-new/05-2181-policy-through-dialogue-response.pdf>

Vitae-CROS (2009). Vitae Careers in Research Online Survey (CROS): UK aggregated UK results 2009. <https://www.vitae.ac.uk/vitae-publications/reports/cros-vitae-2009-october.pdf/view>

Vitae-CROS (2011). Vitae Careers in Research Online Survey (CROS): 2011 UK aggregated results. <https://www.vitae.ac.uk/vitae-publications/reports/cros-report-vitae-2011.pdf/view>

Vitae-CROS (2013). Vitae Careers in Research Online Survey (CROS): 2013 UK aggregated results. <https://www.vitae.ac.uk/vitae-publications/reports/cros-report-vitae-2013.pdf/view>

Vitae-PIRLS (2011). Principal investigators and research leaders survey (PIRLS). <https://www.vitae.ac.uk/vitae-publications/reports/pirls-report-vitae-2011.pdf/view>

Vitae-PIRLS (2013). Principal investigators and research leaders survey (PIRLS). <https://www.vitae.ac.uk/impact-and-evaluation/pirls>

Watermeyer, R. (2011). Challenges for university engagement in the UK:

Towards a public academe? *Higher Education Quarterly*, 65(4), 386–410.

Watermeyer, R. (2014a). Issues in the articulation of 'impact': the responses of UK academics to 'impact' as a new measure of research assessment. *Studies in Higher Education*, 39:2, 359–377.

Watermeyer, R. (2014b). Impact in the REF: issues and obstacles, *Studies in Higher Education*, DOI:10.1080/03075079.2014.915303.

Watermeyer, R. (forthcoming a). Public intellectuals vs. new public management: The defeat of public engagement in Higher Education. *Studies in Higher Education*, DOI: 10.1080/03075079.2015.1034261.

Watermeyer, R. (forthcoming b). Lost in the 'Third Space': The Impact of Public Engagement in Higher Education (PE-HE) on Academic Identity, Research Practice and Career Progression. *European Journal of Higher Education*, DOI: 10.1080/21568235.2015..1044546.

Watermeyer, R. & Lewis, J. (2015, forthcoming). Public engagement in higher education (PH-HE): state of the art, in J. Case & J. Huisman (eds.) *Investigating Higher Education: A Critical Review of Research Contributions*, Routledge (due out in September).

Wellcome Trust (2000). *The Role of Scientists in Public Debate*. <http://www.wellcome.ac.uk/About-us/Publications/Reports/Public-engagement/wtd003429.htm>

Wilkinson, C. & Sardo, M. (2011). *Negotiated boundaries: The role of social scientists in Public Engagement with Science and Technology (PEST)*. Project Report. University of the West of England. http://eprints.uwe.ac.uk/15658/1/Negotiated_Boundaries_Five_Page_Project_Summary_January_2011.pdf

Wilkinson, C., Bultitude, K., & Dawson, E. (2011). "Oh yes, robots! People like robots; the robot people should do something": perspectives and prospects in public engagement with robotics. *Science Communication*, 33(3) 367–397.

(Lord) Wolfendale (1995). Report of the Committee to Review the Contribution of Scientists and Engineers to the Public Understanding of Science, Engineering and Technology.

Wynne, B. (1992). Public understanding of science research: new horizons or hall of mirrors? *Public Understanding of Science*, 1(1): 37–43.

Wynne, B. (2006). Public engagement as a means of restoring public trust in science – hitting the notes, but missing the music?, *Community Genetics*, 2006(9): 211–20.