

## Research Report

### Talking Robots: A Critical Examination of Strategies for Public Engagement with Robotic Technologies

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#### 1. Background

##### *Public Engagement with Science and Technology*

In recent years engagement has become a 'gold-standard' amongst the range of policymakers, scientists, private sector organisations and learned institutions that aim to communicate and engage publics with science and technology (Felt and Fochler, 2008:489). In European contexts engagement has sought to become more deliberative and inclusive, with methods such as citizen juries, consensus conferences and science cafes promoting greater two-way discussion on relevant scientific issues. Anticipating public reactions can be insightful for technological development involving significant research and financial investment and a number of studies have highlighted the utility of public or localised understanding in creating socially robust knowledge or research (Wynne, 1996; Epstein, 1996).

There are however practical and conceptual issues attached to these styles of engagement activities. They can be time-consuming, expensive and require significant commitment. Evaluation mechanisms have been ad hoc and there is little practical guidance in terms of how and what 'engagement' is. Engagement is perceived as an under-researched and complex process, in particular due to the lingering framework of deficit (Rowe et al., 2004; Irwin and Michael, 2003; Irwin, 2001; Rowe and Frewer, 2000). Engagement mechanisms raise implications around their potential for bridging lay-expert divides (Kerr et al., 2007), the role of scientists (Poliakoff and Webb, 2007), the perceptions of citizens involved in such activities (Felt and Fochler, 2008), their use in commercial sectors (Bunningham et al., 2007) and the 'translation' issue or how public engagement can feed into the policy process (Horlick-Jones et al., 2007). Previous studies have surveyed scientists regarding their aims, motivations and behaviours (Poliakoff and Webb, 2007; Royal Society, 2006), whilst work on the views of citizens within this context remains limited (Felt and Fochler, 2008) despite engagement bringing new public responsibilities to 'represent' and contribute to processes that are encountering practical and ideological challenges (Irwin, 2001).

Science communicators and engagement practitioners are conscious of the need for greater communication, networking and shared learning, recognised in a series of interventions and projects. These include CreScENDO, which sought to create an active network of science engagement projects to share good practice, build capacity and improve engagement work (Measure, 2007), and Small Talk, which encouraged organisations to collaborate when engaging the public with nanotechnologies (Smallman and Nieman, 2006). In 2008 this commitment to sharing engagement within a UK academic context was addressed by the launch of the largest ever initiative to support public engagement, the Beacons for Public Engagement.

### *The Context of Robotics*

Robots are being developed for use in a variety of locations, including the workplace, home, healthcare, and the military. The instillation of robotic machines increased considerably in the late 1990's, most prominently in auto manufacturing, but also in food/beverage and tobacco production, plastics and rubber manufacturing, and the pharmaceutical industries (BARA, 2007). The International Federation of [Robotics](#) (2008) estimated that in 2006 the worldwide stock of industrial robots stood at over one million, with 1 robot per 10 workers in the motor vehicle industry. For personal use in the home, sales of vacuum cleaning robots are at 2.35 million units, and lawn mowing robots at 91,000 units. Despite these numbers, robotics has not progressed as predicted by researchers or imagined in science fiction. Artificial intelligence and autonomy have developed more slowly than predicted; robotic elements are often shrouded in mechanistic forms; and the definition of 'robot/robotic' remains an area of academic debate (Trevelyan, 1999).

Compared to other emerging scientific and technological fields, robotics is relatively under-researched where public attitudes are concerned. Human robot-interaction studies are most common, but focus on specific issues impacting on the design of robots and their interface with humans (Blow et al., 2006; Dautenhahn et al. 2006; Goetz et al., 2003). A study in the late 1990's examined science fiction and literature presentation of intelligent service robots, followed up by a survey of 134 people in Sweden and a small number of interviews (Khan, 1998). Similarly, a project in 2005 comprising a survey of over 2,000 people in Switzerland explored how people wanted to share their bodies and lives with robots (Arras and Cerqui, 2005). Robotics is interesting from an engagement perspective as the robot itself may 'participate' in engagement (Breazeal et al., 2003), for example hands-on robotic-based challenges or problem solving with Lego Mindstorm kits is feasible as a path to scientific literacy (Sullivan, 2008). This technological integration within an engagement setting is often impractical within other fields, due to health and safety considerations, practicality or a lack of ability to perceive the developments with the human eye. This project then provided an opportunity to explore both engagement with robotics and attitudes to the emerging field.

## **2. Aims and Objectives**

The project aimed to:

- Investigate existing public attitudes to robotic technologies and their potential social impacts.
- Examine engagement strategies and their effectiveness, using robotics engagement events as examples.

The key objectives were to:

- (i) Analyse current public attitudes and views to an emerging and significant area of controversial techno-scientific development (robotics).

*Achieved via the completion of 33 semi-structured interviews with members of the public including questions on current attitudes and perceptions with regard to robotics.*

- (ii) Study the process of engagement between a variety of scientists, academics, communicators and audience participants.

*Achieved via 11 structured observations and 8 video observations, accompanied by 61 semi-structured interviews exploring current attitudes and perceptions with regards to public engagement.*

- (iii) Assess the impact of a range of engagement mechanisms including; public meetings, forums, live events and hands-on workshops.

*Achieved via 11 structured observations and 8 video observations of a diverse range of activities including science cafes, exhibits, a summer school, shows, demonstrations, craft workshops, art installations, discussion-based activities and expert lectures (analysis ongoing).*

### **3. Methods**

Robotics researchers, science centres and/or science communicators coordinating robotics focused engagement activities were contacted across the duration of an eight-month data collection period (June 2007-January 2008) to fulfil a quota sample of 10 engagement activities. The project elicited links into these communities via the 'Walking with Robots' network and other professional connections, providing tremendous added value for the 'Talking Robots' project as funding was separately sourced by the event organisers for devising and delivering the engagement activities.

'Few previous projects have sought to capture information across a series of unrelated but parallel engagement activities. It is important to distinguish that this project did not seek to systematically analyse, compare or evaluate the activities occurring in a normative manner (Rowe et al., In press; Kasperson, 2006) or create singular accountability mechanisms for these types of approach (Healey, 2004) which was beyond the scope of this project. 'Talking Robots' was exploratory in nature and has utilised predominantly qualitative methods.

Eleven groups agreed to allow their projects to be included. Details of their format, locations and 'audiences' can be found in Figure One. Each of the eleven projects incorporated at least one observed engagement 'activity' (in some cases occurring on a single occasion, for others spanning a programme of work), including repeated structured observations by multiple researchers, usually supported by video recordings. At all but one of the activities two researchers performed structured observations, the remaining event being observed by one researcher only. The activities were selected to provide both similarity and contrast in terms of format, duration, target audience, levels of audience participation, venue and geographic location.

Video recordings were made at eight activities in total. Five activities were recorded using two cameras and three activities were recorded using a single camera, producing approximately fifteen hours of video footage. This methodology built on previous work where video has been used to examine interaction in classroom and exhibition settings (Coffey et al., 2006; Dicks et al., 2006; Heath et al., 2002; Widodo 2002). Cameras were not used where there were health and safety implications, or where it was felt by the researchers or organisers that cameras would be

inappropriate or impact on the situation. The analysis of the video and observation data is ongoing.

The project incorporated interviews with three types of participants. 'Engager' refers to speakers or facilitators within activities; 'organiser' means those who were involved in the creation or organisation of an activity, from a 'back stage' perspective; and 'audience' refers to remaining participants, though we recognise that many of the 'audience' had considerable expertise and were far from passive as the term may imply.

The interviews sought to explore attitudes to the engagement experienced, reflection since the event and perceptions on the impact on attitudes. Semi-structured telephone interviews were carried out with all three groups in the seven days that followed the event in order to allow a reflective period for participants. However for certain locations (for example at science centres and museums) it was necessary to interview participants *in situ* due to significantly increased success in participant recruitment when interviews were carried out at the event location. This approach enabled interviews (n= 61) to be conducted with a range of participants, including 'audience' participants (n=33), but also 'engager' participants (n=11) and 'organiser' participants (n=17). A comparable series of interview questions were asked of each group.

The interview data were recorded digitally and transcribed. The transcripts were coded and analysed using the qualitative software programme NVivo. A coding frame (see Figure Two) was then developed between the three researchers based on Ritchie and Spencer's (1994) five-step framework analysis. This involved a process of (i) familiarisation; (ii) thematic framework identification; (iii) indexing; (iv) charting; (v) mapping and interpretation.

The observation methodology was refined through a pilot activity (not included here) and interview questions were revised after the completion of 3 activities. Ethical approval was granted by the Faculty of Health and Life Sciences, UWE, Bristol and followed procedures recommended by the British Sociological Association.

#### **4. Results**

This section summarises the key findings pertaining to the semi-structured interview data. The video and observational data analysis is ongoing and will be written up for publication in 2009.

##### *Existing public attitudes to robotic technologies and their potential social impacts*

Robotics was identified as specifically having relevance for public engagement. A number of audience members assumed and stated that robotics was particularly of interest to young people, a 'compelling and attractive' way to get them thinking about engineering and science. For organisers robotics was suited for engagement as it could provide technology or equipment that can be relatively amenable to hands-on activities. They also described a general perception of robotics being of public interest, 'everyone loves a robot story', it being topical, contemporary and linking to science fiction or areas people could relate to. For one engager this had significant implications:

Cecile: Whenever anyone says [in the department] oh we must do something for the public, everybody immediately says, 'oh yes, robots! People like robots. The robot people should do something'.

Interviewer: And how do you feel about that?

Cecile: Um...I have mixed reaction to that because I think they're right that robots are much more, immediately engaging than any other obvious thing you can do...but on the other hand it does tend to be a bit unfair in terms of who has to do the work. (Cecile, engager, Activity 6: Robotics Expert with Demonstration)

In terms of applications, domestic and industrial applications were most commonly associated with robotics, such as toys, hoovers, or dishwashers; 'we don't have robots in the house other than the washing machine and the tumble drier [interviewee laughs].' Here the influence of science fiction or advertising was asserted; ' [the Renault advert is]not representative of what they [robots] can do and I think if you hear of people losing jobs and things like that to them it's a worry.' Positive descriptions were commonly followed by the caveat that there were potential issues of controversy around the use of robotics in industry, an issue Janet, an engager anticipated:

We go out to the school and everybody is really excited about the robot and one little girl says 'my dad works in a factory and you're trying to put him out of work' and no one actually brought that up here...I'd expected that. (Janet, engager, Activity 10: Science Café on Artificial Intelligence)

Engagers suggested the military use of robotics was controversial; 'handing over responsibility' to the robot for a weapon seen as morally challenging, in contrast to the positivity of remote control mine clearance. Military applications were raised by only a small number of audience participants, and were discreet within exhibits or discussions suggesting a reluctance to emphasise this area too greatly. Medical and social care examples were also less common, though audience participants and engagers cautiously discussed feasible safety measures. Common to all identified applications of robotics was recognition of human replacement, both positively and negatively.

Engagers and audience participants alike raised the issue of shifting definitions of 'robots'; how programmable or humanistic something needed to be, making comparisons to checkout staff and the like. Audience members described robots mimicking human 'actions' and even 'thoughts' or the 'human soul'. Engagers and organisers mentioned contrary views, suggesting audience perceptions of robots 'walking about' or looking human was drawn from science fiction, though they too discussed autonomy and ethical issues associated to 'humanising' robots.

Audience participants referred to the computerised, programmable and artificial intelligence abilities of robotics, how automated, how much memory it needed or whether it simply operated remotely: 'robots I think that's been pre-programmed to do something...with cyborgs I think it's something more...to compliment the human, rather than having it's own intelligence.' However, they also associated robots with mechanical, machines and metallic descriptions, metal bodies, 'big flashy things'.

One organiser was quick to highlight that this made people oblivious to the reality of robotics:

Everybody expects to see robots walking around like C3PO only more clumsy...the old cliché is that everyone said 'well in the year 2000 we'd all have robot people washing up for us and robot servants round our house', but actually we have got them, they just don't look like metal Mickey...They're actually your dishwasher, and your video recorder, and your sky plus box...they're all robots and they do specific tasks, but they're designed to just disappear and be invisible. (Dan, organiser, Activity 2: Robotics exhibits at a Science Museum)

Many asserted and recognised media-based descriptions; adverts on television, a variety of films, TV programmes, and science fiction writing. A gap was perceived between reality and public perceptions, that robots needed to become more embedded in reality. Participants also responded to questions in what we have termed a comprehensive response, 'there's a broad spectrum', 'it's all around us', or they did not feel they could offer a singular definition of a 'robot'.

Engagers and audience members alike felt aspects could be controversial, these included ethical implications and questions about AI or machine consciousness. Audience members described how humans are valued or replaced, and the accomplishment people can get from what may be perceived as a repetitive or dull task. They also referred to the negative association of creating a servant/master type relationship, referring to robotic designs within a utilitarian objective. Engagers shared a range of concerns about when a robot becomes an entity, how we define intelligence, people's emotional connections to robots, responsibility for behaviours or choices a robot might make. An exhibit organiser, Jonathan, described the types of what he called 'eeky' reactions he noted to different robotic exhibits:

Interviewer: And what were the ones that you think were 'eeky'?

Jonathan: Um people, you know, people had problems with the robotic teddy bear

Interviewer: The one with the fur on the outside?

Jonathan: Yeah...something that isn't more than just engaging in a film or a video game, people suddenly get very kind of concerned about robots and that kind of interface between kind of, particularly care and machines...the huggable, the MIT Teddy Bear, there was like 'Oh my God, I'm not quite sure if this is right!' types of conversations.' (Jonathan, organiser, Activity 4: Robotics and Design Exhibition)

#### *Engagement strategies and their effectiveness*

The findings suggested that for engagers and audiences alike a professional or pragmatic choice frequently governed their motivation to participate; it was part of their job role, added to a CV, filled a half-term holiday or had 'decent wine and food'. Additionally, audience members described being 'entertained', alongside enjoyment, interest and an opportunity to feel one was participating. Engagers also discussed making activities entertaining and enjoyable partly as self-motivation: '[I

enjoy it] because of the performance in the sense that for me...every lecture, or every talk is a gig as far as I'm concerned.' Audience members, including adults, described an interest in 'learning more', the educative attraction of the activity. Scientific literacy arguments implicitly underlined many comments:

I worry very much that, huge parts of the youth of today is doing media studies...very few are doing pure science and I compare us with a lot of the other countries where there's a much greater interest...[science] is neither seen as being lucrative or leading to a good career... I worry about the lack of Nobel Prize winners that we have, I worry about the lack of patents that we have. (Michelle, audience member, Activity 2: Robotics exhibits at a Science Museum)

Engagers were keen to hear new views on their work: 'good questions that you get from people outside your own field can really make you examine some of your assumptions'. This function extended to engagers that were experts in their field, but novices to public engagement:

I was very interested to see...how you can get the public engaged with the science and the technology, how you communicate it, how they can engage with it, and how you generate feedback from that, it was really interesting for me just to see how the whole thing played out. (Kevin, Engager, Activity 11: Discussion Events in Science Café Style)

The idea that audience members could provide something for experts was occasionally highlighted by audience participants, although this attitude was rare; '...I'd like it to be a two way thing, he comes to tell us about robotics and stuff, and it would be quite nice for us to come and tell him what we think about it and ask more questions'.

The interviews provided an opportunity to explore the types of functions public engagement could have in policymaking. For many audience members it simply had not occurred to them before that their views may be of interest. Comments about the need to have such informed decision making frequently alluded to traditional notions that experts are best placed to present 'both sides of the argument' or to 'educate' prior to decisions being made: 'I certainly am uncomfortable with decision making in the absence of knowledge which is a big risk at the moment'. Some audience members also shared concerns, suggesting that often participants were 'informed' in the sense that they already had an interest or motivation, scientific or political to participate; 'it's a case of possibly too many cooks spoil the broth'. Though audience members discussed the democratic contribution publics could have in providing 'common sense', less forthcoming were practical ideas about how this could happen. Writing to an MP, signing petitions, or joining pressure groups were mentioned, but in general the opportunity to influence policy was linked only to active or vocal citizens. Audience participants often rejected this notion of influencing decision making, due to a lack of desire, interest or concern, even being 'too old' and it best left to future generations.

Participants identified economic motivations to encourage public engagement. Engagers and audience participants discreetly referred to the need for a broader scientific literacy to encourage economic competitiveness and student recruitment.

They also saw engagement fulfilling a public understanding of science agenda, whereby its key motivation was providing an educational role. It was not always the case that audiences identified or were personally motivated to be involved in a more two-way process.

Scepticism was expressed regarding how public engagement worked in practice, identifying it as a somewhat cynical or rhetorical device. Engagers cast doubt on how much scientists or policymakers listened to public concerns. Questions around this issue were often met with uncertainty by the interviewee, along the lines of 'that's difficult', 'that's a tough one', or 'I will need to think about that'. This was not a reflection on the question wording but difficulty with that type of objective. Across all groups there appeared to be a lack of ability to connect individual activities they might participate in and how that could be part of a bigger picture.

Practical and perceptual issues emerged as impacting on the engagement experienced. Facilitation was crucial to activities such as science cafes and discussions; '[there] wasn't enough time to really go into issues... it really would have benefited from, a moderator in each space, because there were some people who dominated'. Whereas in discussion activities, a hard line (or 'crowd control' as one engager coined it) was constructive, in activities with other groups a 'softer touch' came through as valuable. In workshop activities (the summer school and exhibits) the value of encouraging participant led interaction was highlighted:

The robotics co-ordinator, had a particular style...he lets them use their imagination to get on with it. Although he's there hovering in the background to help...he's not coming at them and telling them what to do, and I like that approach, because it then teaches the boys responsibility for their own learning. (Ben, organiser, Activity 3: Robotics 'Summer School')

Organisers and engagers mentioned the value of having 'real experts', and expert interaction, as key in demystifying science, creating interaction and providing role models. It is notable that engagers and organisers saw this as 'added value' for participants, whereas for audience members it simply fulfilled an expectation. Perceptions of expertise by organisers and engagers recognised the expert role of publics; 'You don't have to have a bunch of degrees after your name to have opinions, and to be able to think rationally and logically...to engage in useful and meaningful dialogue'. Audiences also had expectations about what an 'expert' implied:

Toby: when I hear somebody who is important speak, I like for them to have an opinion and for me to be able to judge that opinion on its pros and cons, to hear their argument, to hear it brought through to conclusion

Interviewer: and does it matter to you, how do you gauge whether a person is important?

Toby: well first of all she was speaking in front of a room of people suggested that she was important, the billing sheet, you know the poster for science café said that she was important and she purported herself to be important, she started out her talk by saying, by giving her qualifications, saying where she worked and what field she worked in and all that sort of stuff, so for



somebody who says they're important to give an argument as if they weren't important was not, not as interesting as it could have been. (Toby, audience member, Activity 10: Science Café on Artificial Intelligence)

Audiences noted various presentation skills; some liked humour, personal experience and stories, others criticised casual methods or 'rambling', preferring structured, concise information. There were contradictory expectations with regards to audience input and question asking, some expressed disappointment at the lack of opportunity for questions or discussion, whereas others liked to passively listen. For discussion-based activities, moving to true 'discussion' amongst groups was often problematic. In some of the science centre work the more periphery approach of engagers resulted in some lengthy individual discussions motivated by audience members.

Organisers differed in their approaches to preparing or briefing engagers, with some suggesting they 'grilled' potential experts or checked past experience to gauge how well they could engage, whilst others appeared to take a laid back approach, leaving the 'interpretation' up to the engager. In engager interviews, where training or effective briefing occurred it was a non-issue, whereas for those lacking in such support it had a tendency to dominate interviews. Poor briefing was mentioned by some engagers, who felt greater planning or understanding of the activity would have improved it. Time often limited such briefing and feedback for one-off activities or events, particularly when occurring as an add-on to existing work. Some organisers assumed someone who is an expert or well-versed in public speaking would not need additional advice or referred to engagers disregarding instruction. Organisers also mentioned that audiences could sometimes be serious and formal, making engagement through casual approaches difficult.

Logistical issues effected activities, from recruitment to microphones, inappropriate venues and timekeeping. Whilst minor issues, they could heavily impact on audience perceptions, in Activity 7 a 'Robot' Building /Craft Workshop was carried out in two rooms, the logistics of moving children significantly impacted on views of the activity.

### *Conclusions*

These results aid debates regarding the influences of the media on the emergence of topical issues in science and technology but suggest an active awareness (in terms of the influence on their engagement) amongst both scientific experts and members of the public (Irwin, 2001). At present the comparably positive depiction of robotics provides an opportunity to attract publics to engagement. Controversy may occur around the use of robotic technologies within domestic settings, and further research is warranted here as the technologies reach maturity (Fong et al., 2003). Worries around their use in industry, whilst rarely explicit within this project, may further emerge with current employment concerns.

In the context of this relatively small project, people are motivated to participate for pragmatic, practical and personal reasons; how that relates into a broader contribution or policy role is unclear to many participants, who assert their identity as lay people (Michael, 1998). Traditional motivations are often more obvious: arguments around scientific literacy, understanding and awareness. The ethos to be engaged exists but it is often verbalised in a more traditional expectation that expertise be provided for publics.

## **5. Activities**

### Conference Posters

Wilkinson, C. E., Bultitude, K. and Dawson, E. (2008) Talking Robots: Examining Public Engagement with Emerging Robotic Technologies. British Sociological Association Annual Conference, University of Warwick, 28<sup>th</sup>- 30<sup>th</sup> March 2008.

### Conference Papers

Dawson, E., Wilkinson, C. and Bultitude, K. (2008) Talking Robots: A Critical Examination of Strategies for Public Engagement with Robotic Technologies – An Update. RoboFesta, Milton Keynes, 6<sup>th</sup> November 2008.

Dawson, E., Wilkinson, C. and Bultitude, K. (2007) Talking Robots: A Critical Examination of Strategies for Public Engagement with Robotic Technologies. RoboFesta, Milton Keynes, 1<sup>st</sup> November 2007.

### Seminars

Dawson, E., Wilkinson, C. and Bultitude, K. (2008) Talking Robots: A Critical Examination of Strategies for Public Engagement. STEG Research Group, Kings College, London, 10<sup>th</sup> January 2008.

Advisory group meetings were convened in September 2007 and October 2008. A preliminary report and a virtual meeting with the advisory group was held in the interim period (July 2008).

## Annex

Engagement mechanism	Location	Setting	Audience type	Audience size (approx)	Methods
Activity 1: Robotics Expert lecture + Q&A	South West of England	Community Hall	Retired - 60+	150	Observation X 2 researchers Video Camera X 2 Interviews X 7
Activity 2: Robotics exhibits at a Science Museum	London	Science Centre/ Museum	Mixed family audiences	-	Observation X 2 researchers Video Camera X 2 Interviews X 5
Activity 3: Robotics 'Summer School'	London	University Campus	13-14 year olds	18	Observation X2 researchers Video Camera X 2 Interviews X 7
Activity 4: Robotics and Design Exhibition	North East of England	Science Centre/ Museum	Mixed family audience	-	Observation X 2 researchers Video Camera X 1 Interviews X 6
Activity 5: Robotic Show/ Presentation	North East of England	Science Centre/ museum	Mixed family audience	40	Observation X 2 researchers Video Camera X 2 Interviews X 6
Activity 6: Robotics Expert with Demonstration	North East of England	Science Centre/ Museum	Mixed family audience	-	Observation X 2 researchers Video Camera X 1 Interviews X 6
Activity 7: 'Robot' Building /Craft Workshop	North East of England	Science Centre/ Museum	Mixed family audience – under 10's	25	Observation X 2 researchers Video Camera X 1 Interviews X 6
Activity 8: Robotic Art Installation	North East of England	Science Centre / Museum	Mixed family audience	-	Observation X 2 researchers Interviews X 2
Activity 9: Robotics Visions Conference	London	Learned society	16-18 year old students	20	Observation X 2 researchers Video Cameras X 2 Interviews X 5
Activity 10: Science Café on Artificial Intelligence	South West of England	Public House	Adults of mixed ages	80	Observation X 1 researchers Interviews X 6
Activity 11: Discussion Events in Science Café Style (with experts present)	London	Science Centre/Museum	Adults of mixed ages	90	Observation X 2 researchers Interviews X 7

Figure One. Engagement Activities

<b>Talking Robots Coding</b>		
<b>1. Aims or Motivations of Engagement</b>	1.1 Cultural Role	1.1.2 Communication (17) 1.1.3 Enjoyment (43) 1.1.4 Interest (33) 1.1.5 Participation (14)
	1.2 Educative Role	1.2.1 Learning, information and awareness (48) 1.2.2 Recruitment (25) 1.2.3 'Bottom up' nature (13)
	1.3 Networks (21)	
	1.4 Policy Role	1.4.1 Informing policy (14) 1.4.2 Informing public opinion (14)
	1.5 Professional or Pragmatic Role (49)	
	1.6 Societal Role (20)	
<b>2. Attitudes Towards Robotics</b>	2.1 Applications of Robotics	2.1.1 Domestic (29) 2.1.2 Human Replacement (49) 2.1.3 Industrial (20) 2.1.4 Medical and Social Care (11) 2.1.5 Military (17)
	2.2 Descriptions of Robots	2.2.1 Anthromorphic, Animals and Insects (43) 2.2.2 Comprehensive (8) 2.2.3 Computers, Programming and AI (40) 2.2.4 Mechanical, machines and metal (21) 2.2.5 Media-based descriptions (42)
	2.3 Perceptions of Attitudes	2.3.1 (Un)awareness of robotics (31) 2.3.2 Controversial (38) 2.3.3 Future or now (20) 2.3.4 Negative (29) 2.3.5 Positive (16) 2.3.6 Progress (or not) (17) 2.3.7 Reality (11)
	2.4 Robot Rights	2.4.1 AI or machine consciousness (38) 2.4.2 Ethics (49) 2.4.3 Utilitarian (10)
<b>3. Attitudes towards Science and Technology</b>	3.1 Positive (14)	
	3.2 Questioning (26)	
	3.3 Role of Expertise (15)	
	3.4 Science within the world (35)	
	3.5 Significant (5)	
<b>4. Engagement Behaviours</b>	4.1 Facilitation (25)	
	4.2 Perceptions of 'expertise' (48)	
	4.3 Perceptions of 'publics' (57)	
	4.4 Presenter Skills (43)	
	4.5 Question Asking (30)	
	4.6 The value of 'expert' interaction (13)	
<b>5. Engagement Practicalities</b>	5.1 Briefing and Feedback (22)	
	5.2 Collaboration (17)	
	5.3 Logistics (48)	
	5.4 Preparation (16)	
<b>6. Policy Role of Public Engagement</b>	6.1 Cynicism and Rhetoric (22)	
	6.2 Decision Making	6.2.1 Democratic (31) 6.2.2 Informed (41) 6.2.3 Rejection (15)
	6.3 Economic (7)	
	6.4 Future Generations (4)	
	6.5 Public Understanding of Science (7)	6.5.1 Information (25)
	6.6 Uncertainty (21)	
<b>7. Robotics and Public Engagement</b>	7.1 Robotics of interest (young people) (9)	
	7.2 Robotics of Public Interest (14)	
	7.3 Robotics Requires Engagement (7)	
	7.4 Robotics suited for Engagement (12)	

Figure Two: Coding for Interview Data

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