Robot Thought – A Dialogue Event for Family Audiences

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Abstract

An original and highly successful public engagement event format has been devised for encouraging family audiences to consider and convey their opinions on issues associated with robotics technology. The format uses the traditional approach of an entertaining science "show" to appeal to young and old alike. The show is broken down into a series of short dramatic vignettes to highlight important practical, personal and social issues relating to robotics. During each vignette a particular concept or issue is presented to the audience, who are then encouraged to express their opinions and concerns about issues, and debate the implications of robotics on future society. This paper describes the key features of the event format, with particular reference to the successful pilot performances held during October 2004.

1 Introduction

Robotics is a subject that is capable of drawing the public into engagement with many aspects of science, technology, engineering and mathematics. The University of the West of England's Intelligent Autonomous Systems (IAS) laboratory[1] has one of the largest and best regarded mobile robotics research portfolios in the UK and a long history of finding ways of taking their expertise to non-specialist audiences through demonstration lectures and events. This project involves a partnership between the IAS laboratory and the Graphic Science Unit[2], innovative science communication specialists based at the University of the West of England, who have an international reputation for devising interesting ways of engaging public audiences with science and engineering.

A major market has recently been established for robots designed for recreational purposes. One of the best known examples is Sony's robotic dog, the Aibo. These have increased public interest in robotics, and an opportunity exists to build on this foundation to draw the public into considering both the engineering challenges and ethical issues that are raised by work in the field. These two topics are strongly linked because the public tend to overestimate the technical capabilities of existing robots, and consequently have concerns about them that are based more on science fiction than science fact.

Robot Thought is an innovative event format that highlights issues pertinent to current research in robotics. Some of these issues are technical, [e.g. "How do you create robots capable of navigating in complex environments?"]; others are ethical [e.g. "Who would be responsible for the behaviour of an autonomous robot?" or "If robots had emotions would we have to treat them differently?"].

1.1 Rationale

Successful public engagement with robotics research requires two-way communication, offering the facility for public audiences to convey their own

[1] http://www.ias.uwe.ac.uk/
[2] http://www.uwe.ac.uk/fas/graphicscience/

attitudes and opinions, as well as the opportunity for the researchers to demonstrate their work (Jenkin 2000). Inclusivity is further encouraged through careful design of the public event format, combining both entertainment and educational aspects of the topic. These were the key motivating factors in the design of the *Robot Thought* format.

Student retention within science subjects, particularly the physical sciences, has dramatically decreased in recent years. The recent student-led review of the national science curriculum (commissioned by Planet Science in 2002) concluded that having a discussion or debate was the most effective way of learning, whilst 57% of students surveyed agreed that introducing discussions about philosophy and ethics would definitely make GCSE science subjects more attractive as a subject. This event format is therefore specifically designed to raise issues within robotics research, and encourage consideration and discussion of those issues within the audience. *Robot Thought* therefore encourages greater interest in science and engineering amongst young people attending the performances.

Certain constraints were placed on the event structure in order to maximise transferability and flexibility. These included:

- No requirement for specialist staging, for example sets, lights, etc
- All effects are deliverable through a laptop and a data projector
- No requirement for professional actors

Robot Thought is therefore capable of being mounted by individuals and organisations for whom the event would be attractive, but who do not necessarily have access to theatre expertise and equipment [for example University departments or robotics R&D specialists]. This maximises the possible dissemination routes and allows the event format to be adapted to be suitable for as wide a range of locations and audiences as possible.

1.2 Target Audience

The target audience is primarily family groups, consisting of both adults and young children (typically aged 4–12). The event format was effective across a considerable spectrum of audiences, principally because the dramatic vignettes engage the audience at a number of different levels, and the level and focus of the discussion can be adjusted to suit the background of the audience.

The interactive nature of *Robot Thought* makes it most suitable for relatively small groups (up to ~100 people), where each audience member has the opportunity to feel directly involved in the performance. It is adaptable to a wide variety of venues, from science centres to University open days to shopping malls.

2 Event Design

The project team encompassed a variety of expertise relevant to the project, including robotics researchers, professional science communicators, and a representative from the pilot venue, At-Bristol. Each of these team members was thoroughly consulted during the design process in order to produce the most effective event format possible. For example, the input of the local venue representative provided invaluable knowledge regarding likely audience sizes, ages and backgrounds, and ensured that the show would suit the chosen venue, and engage the target audience as much as possible.

2.1 Audience Pre-Research

The target audience for *Robot Thought* was thoroughly researched at the beginning of the project. This ensured that the event format was tailored specifically for the target audience of family groups. A brief description of the audience pre-research is included below; the full report is available at:
www.uwe.ac.uk/fas/graphicscience/projects/robots.htm

There were four key data sources for the audience pre-research:

1. Visitor demographics from At-Bristol
2. Analysis of visitor responses to the *Hot Topics* exhibits – a suite of computer-based exhibits related to robotics issues that have been a popular feature of Explore At-Bristol since the centre opened in 2000. They were designed by the Graphic Science Unit at UWE, and provide visitors with the opportunity to compare their responses to other visitors of the same age and gender.
3. Interviews with visitors to At-Bristol – structured questionnaire-based interviews were conducted during school holidays and over a weekend in order to obtain similar audiences to that expected during the timing of the pilot performances. A two-tier approach was used to differentiate the audience: adults were interviewed by an adult using a written questionnaire, whilst children were interviewed by a child (the 8-yr-old son of the evaluator) using a tape recorder.
4. Structured group discussions with school children – a selection of robots were taken into a primary school and used to prompt students' debate (years 3-6) about the nature and parameters of robotics.

2.1.1 Summary of Key Pre-Research Findings

- The audience within Explore At-Bristol out of term time is largely made up of mothers or grandparents with children.
- There is a pervasive and well developed scepticism about the potential abilities of future robots.
- When thinking about close-up interactions with robots, most adults limit the useful role of robots to housework and occasionally other menial tasks. Children tend to focus more on leisure pursuits.
- There is a widespread ignorance about the current state of robotics technology. Most adults and children do not realise that robots are already involved in complex and challenging tasks, particularly in space and conflict zones.
- Almost nobody in the adult sample believed that robots would ever achieve a level of intelligence and agency comparable with humans. Younger children, on the other hand, were equally confident that they would.
- Children's views of robots are heavily determined by their physical appearance and their conformity to pre-existing visual stereotypes.
- Some children can differentiate robots by their ability to perform complex tasks, such as walking and talking.
- Only a very few younger children have any grasp of the concept of autonomous robots.
- A robot ranking game might be an accessible and appropriate way to introduce children to the concepts this project seeks to raise.

2.2 Presenters

A deliberate decision was taken not to use professional actors in the performance of *Robot Thought* to ensure maximum transferability to other venues. The presenters for the pilot events were experienced at communicating scientific concepts to the target audience through a performance medium: science shows. They were specifically NOT familiar with robotics. The key characteristics of the presenters were their enthusiasm, ability to react and respond to the audience's opinions, understanding of their audience, and ability to comprehend and explain the necessary concepts of robotics technology. There are many such presenters throughout the UK that would be capable of presenting *Robot Thought*, which should assist with dissemination of the event format.

2.2.1 Presenter Training

The presenters were sent briefing materials in advance of the performances. This pack included articles and websites aimed at the general public, and provided further background to the issues and topics raised within each of the performance vignettes. The presenters also visited the IAS lab at UWE in order to, firstly, gain an appreciation of the current state-of-the-art in robotics research and, secondly, so that *Robot Thought* would be directly informed by the particular themes of research in the IAS lab. These themes include biologically-inspired robotics and swarm intelligence.

A day-long training session was conducted by the project team immediately prior to the performances, with four key components:

1. *Overview of venue* and discussion with At-Bristol staff – this prepared the presenters for the venue and facilities they would have access to, and allowed transfer of expertise regarding audiences and other logistics.
2. *Pre-research briefing* – A summary of the audience pre-research findings was given in order to inform the presenters of likely issues and attitudes.
3. *Robotics briefing* – The presenters were provided with a short tutorial in the relevant topics and issues in robotics, and given the opportunity to ask questions of the robotics experts in the project team.
4. *Rehearsals* – The science communication experts within the project team facilitated the rehearsals, with the emphasis on conceptual understanding of the issues to be discussed within each vignette, rather than learning a specific script.

2.3 Show Content

The show consisted of five short dramatic vignettes. Each vignette was based around a critical theme in robotics as identified by the project team, and deemed to be of interest by the audience pre-research. The topics of the five vignettes were:

1. What is a robot?
2. Why aren't robots more advanced?
3. What do we want to use robots for?
4. State of current research: UWE example
5. What do we want for the future of robotics?

Further details of each of the vignettes, including a description of the content and explanation for its inclusion, are briefly outlined in the Appendix.

2.4 Evaluation

The pilot performances of *Robot Thought* were evaluated in two main ways:

- *Observations* – All of the performances were observed by an evaluator, who took extensive contemporaneous notes on the size, composition and reactions of the audience.
- *Questionnaire-based survey* – The attitudes of adult members of the audience towards the show were investigated using a survey consisting of a series of closed questions.

One performance was also recorded on video for documentation purposes.

The full evaluation report, including a copy of the survey questions, is available online at:
www.uwe.ac.uk/fas/graphicscience/projects/robots.htm

3 Pilot Performances

3.1 Venue

The pilot performances were held at At-Bristol, a world class science centre located in Bristol. The performance space was situated directly on the exhibition floor at Explore At-Bristol, surrounded by other exhibits and demonstrations. Computer projection facilities, microphones and a speaker system were in use during the pilot performances, but no specialist dramatic equipment (lighting, sound effects) were used.

3.2 Publicity

Good publicity is crucial for any outreach activity, to ensure that the event reaches its maximum possible audience. In the case of the pilot performances this included press releases, inclusion in At-Bristol's "What's On" flyer (circulation: 40,000 within the South West region); article in the Bristol Observer (free local newspaper distributed to 180,000 homes within Bristol), announcements and notices within At-Bristol on the day.

3.3 Timing

Six performances of *Robot Thought* were presented over the course of three days. The timing of the pilot performances was specifically chosen to coincide with the October half-term holiday. In half-term the numbers of family audiences visiting At-Bristol is significantly greater than during term time. The events were held at 1pm and 3pm during the afternoon, again to coincide with the largest concentration of visitors.

3.4 Audience

Table 1 sets out the number of people in the audience at the beginning of each of the performances. The audiences were observed to consist almost entirely of adults and children; very few teenagers watched any of the shows

There was a certain amount of coming and going during each performance. In general the audience size declined by approximately 10% during the first ten minutes and then gradually grew until by the end of the performance it significantly exceeded the figures quoted in Table 1. In particular, Shows 4 and 6 were observed to have well over 100 people in attendance part way through each show.

Table 1 – Preliminary audience sizes for each *Robot Thought* performance

	Adults	*Children*	*Total*
Show 1	26	21	47
Show 2	24	28	52
Show 3	27	28	55
Show 4	38	30	68
Show 5	23	31	54
Show 6	24	32	56
Total	*162*	*170*	*332*

Audience members were most likely to leave at the break between different vignettes, particularly at the end of the robot parade. It was observed that most families who left before the end of the show did so at the insistence of parents. This was more noticeable during the 3pm shows, where travel home (and traffic avoidance) seemed to be an issue. There were no observed instances of children leading their parents away from the show.

With one or two exceptions, children were well behaved throughout the performances and seemed focussed on the show. Questions from the presenters were always met with a rush of raised hands, even when the child in question had no idea what they would say. There was very little interaction between children during the performances, and where they were talking to each other it was usually a disagreement over something in the show.

There was fierce competition to be picked by the presenters as a volunteer and occasionally some disappointment among those audience members who were not chosen.

3.5 Survey results

A total of fourteen adults were surveyed after the performances. The sample was roughly gender balanced (6 male, 8 female) and was entirely white. 10 out of 14 members of the sample were aged between 36 and 45, all of whom were accompanied by children. Only one member of the sample was visiting At-Bristol without children. Occupations were mostly professional plus three full time homemakers, a dinner lady and an au-pair. Respondents were selected at random.

12 out of 13 respondents agreed with the survey question "Are you interested in science?". This figure is higher than usually reported from national surveys (at around 70% according to the *Science and the Public* report), and may be a product of the immediate environment (i.e. the type of person

likely to remain behind after a show), representative of those who attend science centres in general, or a correlation with the higher than average socio-economic demographics of the sample group.

Respondents were given a series of statements about the show and asked to rank their attitude on a scale of 1 to 5, where 1 is strongly agree, and 5 is strongly disagree. The results of this survey are summarised in Table 2.

Table 2 – Survey Results

Statement	✓	-	✗
I enjoyed the show	14	0	0
I would recommend this show to a friend	14	0	0
I would like to see the show again	9	1	4
I was interested to hear about robots	12	2	0
I learned about robots	14	0	0
It made me think about robots	12	2	0
I have not thought much about robots before	5	6	3
I am concerned about ethical issues arising from robot technology	8	4	2
I felt able to express my own views	9	4	1
I would like more opportunity to express my own views	4	4	6
✓ = 1 or 2: 'strongly agree' or 'agree' *– = 3: neutral* *✗ = 4 or 5: 'disagree' or 'strongly disagree'*			

Across the board, all reactions were very positive. The show was reckoned to be enjoyable, interesting, educational and thought provoking. All the respondents surveyed strongly agreed that they both enjoyed the show and would recommend it to a friend. There was even interest amongst those surveyed in seeing the show again

Overall, there was agreement with the statement "I am concerned about ethical issues arising from robot technology". Just over half of the sample (8) agreed with this statement, with only two disagreements.

The majority of people surveyed (9) agreed that they felt able to express their own views within the existing show format, but few (4) were interested in having a greater opportunity for that expression. In fact, six respondents actually disagreed with the statement "I would like more opportunity to express my own views". This relatively even distribution of attitudes could reflect the composition of the audience. The *Science and the Public* report has identified the Confident Believers as an attitudinal cluster who can be found among this demographic, and who do not see themselves as lacking in representation or opportunities to voice their opinions. On the other hand, there are a substantial number who are concerned about the future of robotics and who might welcome further opportunities to consider issues akin to those raised in this project. At any rate, these responses would seem to indicate that the majority of the adult audience were satisfied with the time available for discussing personal views.

4 Conclusions

An inventive and exciting event format has been devised to engage family audiences with issues in robotics research. Six pilot performances of the event were held over three days, with tremendous popularity and extremely positive feedback from the audiences.

The event format has been specifically designed to be transferable to a wide variety of venues and audiences.

4.1.1 Key success criteria:

A number of criteria were identified during the pilot performances of *Robot Thought* which significantly contributed to the success of the performances:

- *venue layout* – the space needs to be large enough to perform interactive activities, with the audience close enough to feel involved in the show
- *timing* – needs to coincide with times of high footfall
- *audience targeting* – bi-level content to engage both adults and children
- *entertainment* – toys, visible props, noise, cheering, audience voting, etc.
- *presenters* – enthusiastic, scientific background (but not necessarily in robotics), ability to react to audience
- *real research* – interactive demonstrations, video of real robots in action, and if possible, live demonstration of real research robots
- *issues* – ask audience for their opinions

5 Future Directions

There is strong interest in further performances of *Robot Thought*, from both the science communication and robotics research communities. Supplementary events have already been performed in association with the South West regional branch of the BA (the British Association for the Advancement of Science), and the show is booked to perform at the Cheltenham Festival of Science in June 2005. Funding is currently being sought by the project team to extend the programme to venues across the UK.

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A Appendix 1 – Show Content

This appendix provides further details for each of the five dramatic vignettes within *Robot Thought*. The aim is to deliver both an overview of the content as well as the reasoning behind its inclusion. In this manner there should be sufficient information for interested parties to run their own events within a similar format, yet still be able to alter the content to suit their own audience, background or interest.

A.1 What is a robot?

A.1.1 Robot Toys

As the audience gathered, a range of toys were distributed amongst the children. The toys were specifically chosen to cover the range of characteristics identified during the pre-research as being necessary for a robot: motion, thinking, sounds, runs on batteries and so on. Each toy covered one or more of these characteristics, but the range of toys was selected such that none of the characteristics was covered by every toy. For example, some toys were humanoid in appearance whilst others looked like animals or abstract shapes, and a wind-up alarm clock was included so that not all the toys ran on batteries. The selection was also deliberately focused on *toys* (rather than other potential robotic items) so as to appeal to the younger members of the audience and create a cohesive, recognisable set.

The toys used in the pilot performance were:

- *Robosapien* – remote-controlled traditional looking (humanoid) robot which moved, made sounds, and could be programmed to perform set tasks.
- *Singing lion* – a stuffed toy that either sang or spoke to the user when his ear was pressed. The conversation was fixed, but on first hearing it was believable that the toy was responding to the child's answers.
- *Remote-controlled car* – a car that moved according to remote instructions.
- *Crying doll* – a realistic baby doll that cried until it was picked up, and snored when it was laid down.
- *Transformer* – a plastic toy that could be converted from a truck into a human shape. Included some sounds.
- *Wind-up alarm clock* – a clock that could be made to ring at a set time, and operated without batteries or electronics.
- *Purring cat* – a furry cat that reacted to being touched by purring and moving.

The toys were described by the presenters as being 'possible robots' and the children were encouraged to have a look at their particular toy and decide whether or not they thought it was a robot. They were also prompted to think about what makes something a robot, and encouraged to pass the toys around amongst the audience.

A.1.2 Robot Characteristics

The show started with the audience being asked to look at the toys and suggest what characteristics make up a robot. This section was kept interactive by asking individuals to type in their particular characteristic, which were displayed on-screen to the audience in real time. One presenter was on hand at the laptop during this process to assist younger members. During this period the other presenter individually pointed out the toys in the audience and asked the children to explain what their toy did. As the characteristics were entered on screen the audience was asked to consider whether each of the toys did or did not have those characteristics.

A.1.3 Robot Parade

When the list of characteristics was complete, the children holding the toys were invited to stand in a line. A 'clapometer' competition was run to ascertain which of the toys was 'most' robotic, with the level of cheering and clapping for a particular toy used to determine rankings. Care was taken to ensure that none of the toys was described as an actual robot – the discussion was about whether individual toys were more or less robotic than others.

Once the toys were ranked, the top three were placed on a podium that was visible to the audience throughout the rest of the show.

A.1.4 Robot / Nobot

The presenters discussed the characteristics obtained from the audience, and then asked the audience to consider a series of five images. The audience cheered "yes" if they thought that image represented a robot, and "no" if they thought it was a "nobot". Again, the images were carefully chosen to represent a range of popular robots, including those from film (Daleks, Terminator), a toy robot, real life (the Mars rover), and a person (partly a joke for the adults).

A.2 Why aren't robots more advanced?

A.2.1 Technical Difficulties

The robot / nobot section prompted a discussion about why the robots we see in the movies don't yet exist in real life. The presenters explained that technical difficulties with the software are responsible: although the hardware and mechatronics exists, complete artificial intelligence is still not possible.

A.2.2 Human Intelligence

A visual demonstration enhanced this concept: A volunteer was asked to walk over to a pile of crisp packets, select one that they liked, walk back to the front of the performance area, open the packet of crisps and eat one (after checking with an adult that it was OK). Of course the children had no problems with this exercise – they have proper intelligence.

A.2.3 Robot Intelligence

The volunteer was then told that they had been transported into the future, where they could have their very own robot (one of the presenters with antennae on). They were given a 'communication device' (a microphone) and told that their robot could now perform the crisps task. The difficulty of breaking down the instructions into simple steps clearly highlighted to the audience the futility of having a perfect working robot without intelligence: the simple instruction of 'walk' had to be clearly explained, and much entertainment and humour was gained from the robot misunderstanding instructions, resulting in him stepping on the crisp packets or scattering them all over the floor when he did finally open them.

A.3 What do we want to use robots for?

The audience were asked to consider the future, and think about what they would do with a robot, assuming that the intelligence issue was overcome. The most common response was either 'homework' or 'housework', depending on the age of the respondent. If necessary, the presenters prompted certain professions, such as doctor, soldier, cleaner, partner. Each of these professions was chosen to highlight certain ethical issues related to the future of robotics, such as 'Who is responsible for what a robot does?' or 'Will robots have rights?'. This was particularly poignant during the soldier profession, when the robot had a toy water pistol, and the other presenter asked whose fault it would be if the robot sprayed everyone with the water pistol?! The overwhelming response from the audience was that it would be the controller's fault.

A.4 State of current research

Having set the scene with future applications, the audience were then introduced to an example of current research that is attempting to solve the intelligence problem: swarm intelligence and emergent behaviour. This is a topic under investigation by the robotics experts on the project team, and one which lends itself well to both demonstrations and audience involvement.

A.4.1 Interactive Demonstration

A simple – and very successful – demonstration of swarm intelligence was obtained using members of the audience. Ten volunteers were chosen (and given flashing headsets to indicate they were robots). The volunteers were given three simple rules:

1. Always walk in straight lines using "robot" (small) steps.
2. If you reach the edge of the performance area then just turn around and keep walking straight.
3. If you bump into another "robot", link arms.

After a period of time where the volunteers wandered about the performance space, the above three simple rules resulted in all the volunteer robots having linked arms, and concentrated in one corner of the performance space. The presenters asked both the volunteers and the audience whether they had been instructed to all link arms together and collect in one area – to which the answer was of course no.

The presenters then explained that through having enough robots following very simple rules it was possible for much more intelligent behaviour to emerge.

A.4.2 Research Video

The audience was shown a video of real research performed at the University of the West of England, Bristol. The video started with ten robots situated in a large arena, with black and white Frisbees spaced throughout the arena in a grid-like pattern. It was explained that each robot followed simple rules:

1. Always walk in a straight line
2. If you reach the edge of the performance area then just turn around and keep walking straight in a random initial direction.
3. If you find a Frisbee, pick it up.
4. If you are already holding a Frisbee when you find another one of the same colour then drop your current Frisbee.
5. If you find a Frisbee of a different colour to the one you are holding then turn around and keep walking straight in a random initial direction.

As the (speeded up) video played, the Frisbees were seen to move from a grid pattern into a more random pattern, and then into two distinct piles of separate black and white Frisbees.

A.4.3 Linux Bots

A highlight of the show was the inclusion of 'real' robots for the audience to look at and see in operation. Two Linux Bots, developed at UWE (see Figure 1), were chosen for this purpose as they are sturdy and reliable, and can demonstrate 'interesting' behaviour within a short space of time.

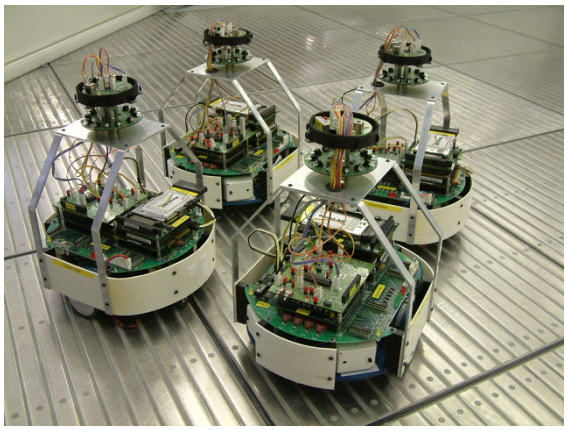

Figure 1: The IAS lab Linux Bots

The Linux Bots were held by the presenters and shown around the audience so that each person had a chance to see them up close. Although this was a relatively time-consuming process there was little fidgeting during this period as the audience seemed spellbound!

A robot arena was set up within the performance space by the members of the audience holding sections of white card. The Linux Bots have infrared sensors at their feet, which work best with white surfaces.

The Linux Bots were placed inside the impromptu arena and the avoidance programme switched on. A "Blue Peter" moment of tension occurred before the robots started working… The Linux Bots move on small wheels, and are programmed such that when they encounter an obstacle they stop and move again in a random initial direction. It was usually clear to the audience that the robots were avoiding the walls and each other, and the presenters emphasised the fact that they were controlling themselves and making their own decisions – there was no-one backstage operating a remote control. The presenters then demonstrated the operation of the avoidance programme by placing their hand near the front of the robots – which of course stopped, and moved off in a different direction. Well-behaved audiences were then invited to try this for themselves, although care was taken to ensure that no one actually went into the arena or touched the Linux Bots.

A.4.4 Podium Changeover

The audience were reminded of the original 'most robotic' toys that remained on the podium positions, and were asked whether they thought the Linux Bots deserved first place. The response was overwhelmingly 'yes', at which point the toys were demoted and the Linux Bots placed on 1st position.

A.5 The future of robotics

The final section of the show was a reminder that the future of robotics relies on the decisions of ordinary people – like the people in the audience. Possible applications of robotics were demonstrated visually on-screen (e.g. finding landmines, dealing with nuclear radiation, deep sea diving, outer space, nanobots) and briefly discussed. This vignette was aimed more at the older members of the audience, but was kept short and snappy to ensure that the children did not lose interest. The audience was encouraged to think about each form of technology and comment on whether they would like to see it used.

The final message of the performance was: "Robots will be what WE make of them" – a deliberately inclusive message designed to place ownership of the decisions and future directions of robotics with the audience.