

Heart Robot

Evaluation Report

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Executive Summary

Project Overview

With support from the Engineering and Physical Sciences Research Council Partnerships for Public Engagement Programme, the Bristol Robotics Laboratory (BRL) devised Heart Robot - a semi-autonomous robot puppet - to engage the public with the concepts and ideas behind research into emotional and social robots.

The project brought together creative, artistic and engineering skills, both to develop the puppet and to engage the public. Direct public engagement took place via walk-about 'performances' of the puppet in unstructured public environments such as street festivals and also at science festivals and science cafes. The intention was to provide a unique interactive experience for predominantly family audiences. The project also created an accompanying website which featured further information about the puppet and the opinions of UK researchers about social and emotional robots.

The project had the following aims:

- To provide publics a hands-on, interactive encounter with the puppet that will stimulate dialogue and encourage awareness and debate around emotional and social robots
- To be present at events not normally associated with science and technology
- To develop a website and other materials that will enable the public to follow-up their interest
- To foster relationships between creative industries and the scientific research community
- To promote the value of public engagement within the research community and provide researchers with an opportunity to observe the public's response to their work

Evaluation methodology

Visits by the evaluator to festivals and other events enabled observation of audience reactions and interviews with audience members (16 aged 12 or under and 48 aged over 12) provided more detailed audience feedback. There was also an electronic survey (completed by 402 respondents) which captured feedback and demographic information about visitors to the website. Further data were collected from a review of media articles (70) in the UK and overseas and a discussion event towards the end of the project, which obtained the views of members of the project team, including collaborators and volunteers.

Project metrics

By 30 September 2008, the Heart Robot project had exceeded its target (601,500 versus a target of 25,200) for potential audiences and intimate encounters (2,812 versus 2,180) and was on course to achieve its target for engaged spectators (7,358 versus 8,200). At the same date, the website had attracted 18,767 unique visitors.

Key findings

- Heart Robot was a highly innovative and successful project. It was extremely ambitious and used a novel approach to communicate some extremely complex ideas and captured the imaginations of public audiences and the media.
- Volunteers and collaborators in the project described their involvement as highly rewarding, with many of them saying they learnt much about themselves and alternative approaches to public engagement.

- Challenges included the nature of the interactions and the characteristics of the events which limited the opportunities for members of the public to learn much about current research or engage in a detailed dialogue with researchers.
- Heart Robot was very well received by audiences and provided a hands-on interactive encounter that stimulated introductory-level discussions amongst members of the public and between researchers and publics. The quality of the engagement was very dependent on the puppeteer and his skill resulted in the wide range of behaviours exhibited by the puppet.
- Successful engagement was achieved at science and non-science events. Audiences at the non-science events predominantly consisted of families.
- The number of unique visitors to the website indicates that those who saw the puppet or heard about it in the media were able to follow up their interest.
- Whilst there is some evidence of collaboration between the creative and engineering communities involved in the project and recognition of one another's skills, there was limited scope for true shared understanding between members of both groups.
- A longer development lead time would allow issues like uncertainty about objectives to be addressed as well as enabling optimum use of project management and design resources.
- Members of the project team were delighted and surprised by the public's responses to the puppet, indicating that they have become more appreciative of public engagement.
- The performance had positive impacts on most audiences. Those at the events found their encounter with the puppet to be enjoyable. It is also shown to have had a positive impact on audiences' attitudes to robots.
- The views expressed by interview subjects and visitors to the website demonstrate success in communicating the project messages. However some of the responses show misinterpretation of the research indicating that the messages were not always clearly understood.

Recommendations

Recommendation 1: The BRL should continue to participate in engagement activities related to social and emotional robots.

Recommendation 2: Expectations members of the project team including collaborators and volunteers should be carefully managed.

Recommendation 3: A longer lead time should be incorporated in future projects to optimise development and facilitate more comprehensive planning.

Recommendation 3: Consideration should be given to creating funding mechanisms specifically for the design and development of public engagement materials.

Recommendation 5: Opportunities for sharing ideas and experience within all members of the project team and between collaborators should be promoted.

Recommendation 6: Reallocation of resources should be possible. Innovative

Recommendation 7: Innovation in the form of creative input to 'science communication' projects should be encouraged.

1 Introduction

1.1 Background

With support from the Engineering and Physical Sciences Research Council Partnerships for Public Engagement Programme, the Bristol Robotics Laboratory (BRL) devised Heart Robot - a semi-autonomous robot puppet - to engage the public with the concepts and ideas behind research into emotional and social robots. Throughout the past decade this research has begun to examine the attributes necessary to integrate robots fully into society, including the possibilities for robots to express intimate emotions or enter into social relationships. These attributes often differ significantly from popular public perception of robots as functional, expressionless machines.

Direct public engagement took place via walk-about 'performances' of the puppet in unstructured public environments such as street festivals and also at science festivals and science cafes. The intention was to provide a unique interactive experience for predominantly family audiences. It was anticipated that the platform of puppetry could reach out to members of the public who might not usually engage with a science activity.

The project also created an accompanying website which featured film clips and images of the puppet, its development and interviews with key UK researchers. The website also sought public opinions via an on-line public survey and a facility for the public to post anonymous feedback. Additional promotional materials were developed in the form of post cards and stickers that featured the web address www.heartrobot.info. The post cards also asked three key questions:

- Could you ever ♥ a robot?
- Could a robot ever ♥ you back?
- How will ♥ robots change us?

An important feature of Heart Robot was its uniting of creative, artistic and engineering skills, both to develop the puppet and to engage the public. The views of the creative and engineering/scientific experts were captured in a documentary film about the project, which also included footage of members of the public interacting with the puppet.

1.2 Heart Robot objectives

The project had the following aims:

- To provide publics a hands-on, interactive encounter with the puppet that will stimulate dialogue and encourage awareness and debate around emotional and social robots
- To be present at events not normally associated with science and technology
- To develop a website and other materials that will enable the public to follow-up their interest
- To foster relationships between creative industries and the scientific research community
- To promote the value of public engagement within the research community and provide researchers with an opportunity to observe the public's response to their work

1.3 Scope of this report

This report details the findings of an independent evaluation of the project.

The evaluation findings are presented in sections 3 and 4 of this report. Section 4 includes observations and audience feedback at events, feedback via the on-line survey and data about media coverage. Section 4 contains the feedback and opinions of members of the project team and other researchers.

1.4 Role of the evaluator

The Heart Robot evaluator independently evaluated the project as a whole. Her task included the evaluation of specific activities both during and after delivery. She sought to identify and document the impacts, success factors, challenges and learning points which could be used to inform the planning and implementation of future public engagement projects.

1.5 Acknowledgements

Jenesys Associates wishes to thank and fully acknowledge all members of the Heart Robot project team for their support and encouragement, especially David McGoran, Dr Claire Rocks and Dr Matthew Studley of the University of the West of England. Their insight and feedback has provided invaluable information for this evaluation.

We also acknowledge the support of Engineering and Physical Sciences Research Council who funded the project through their Partnerships for Public Engagement programme. We would also like to thank the roboticists, animators, film maker and performers who made the project possible.

Special thanks are sent to all those audience members who assisted in providing the vital source data without which this evaluation could not have been completed.

2 The Evaluation

2.1 Evaluation Questions

The evaluation aimed to address the following research questions:

1. Did the project effectively meet its five key objectives as outlined in 1.2 above?
2. What were the impacts of the project on its public audiences?
3. Did the puppet and website represent appropriate media for communication of the project messages?
4. What were the impacts of the project on the creative and scientific/engineering experts?
5. What lessons/good practices are there from this project that would be of use to future practitioners?

2.2 Evaluation Methodology

The evaluation used a mixed-method approach to collect quantitative and qualitative data about the project. There were several strands to the methodology:

- **Observational visits** to festivals and other events were a chance to observe Heart Robot and audiences.
- Questionnaire-based **face-to-face interviews** took place with audience members at festivals. **Postcards** were used to record audience opinions and questions at the Arnolfini Science Café.
- An **electronic survey** provided demographic information and feedback from visitors to the website.
- A **review of media coverage** in the UK and overseas gave some insight into the media's interpretation of the project.
- A **discussion event** towards the end of the project obtained the views of members of the project team, including collaborators and volunteers. Additional views of those who could not attend the event and other researchers, including those who appeared in the documentary film, were obtained via telephone and email interviews.

2.2.1 Observational visits

Six observational visits to events were conducted. Each visit included observation of audience responses to Heart Robot. A selected number of audience members were also interviewed during each visit.

The events visited were:

- Cheltenham Science Festival (7 June 2008)
- Bristol Harbour Festival (3 August 2008)
- Bristol Balloon Fiesta (8 August 2008)
- Creative Technologies Network – Real Robots (16 September 2008)
- The Bristol Do (27 September 2008)
- Arnolfini Science Cafe (5 December 2008)

An 'observational checklist' was developed prior to the visits, and refined during the first visit. This provided a structured but not prescriptive way of recording information and observations about each of the events.

2.2.2 Face-to-face audience interviews

In order to gather information from audience members at festivals, a number of face-to-face interviews were conducted. The structured interviews used two types of questionnaire, one designed for those aged over 12 and one for those aged 12 or less. For a full list of questions see Appendix 1.

2.2.3 Audience Postcards

Participants' at the Arnolfini Science café recorded a wide variety of thoughts and questions about Heart Robot on postcards.

2.2.4 Electronic survey

The electronic survey aimed to provide comprehensive feedback from visitors to the Heart Robot website. It asked respondents for their opinions of Heart Robot as well as their demographic information and how they had heard of the website

A list of questions used in the e-survey is given in Appendix 2.

2.2.5 Media review

This took the form of a review of mainstream coverage of Heart Robot in the UK and overseas.

2.2.6 Discussion event

The discussion event on 29 October 2008 enabled the views of the project team to be obtained in relation to three questions:

- What were your opinions of the puppet and the Heart Robot project as a whole?
- What would you do the same and why?
- What would you change and why?

The discussion event was also a useful opportunity to present the interim findings of the evaluation. Input from individuals who could not attend the discussion event was obtained via email and telephone.

2.3 Evaluation Metrics

At the festivals and other events the observed audience interactions with the puppet were categorised as follows:

'Intimate encounters' were defined as when individuals engaged personally with the puppet. This included touching, speaking to, holding and establishing a relationship with it.

'Engaged spectators' were people who stopped and watched the puppet and its intimate encounters. Their reactions included asking questions, accepting a Heart Robot postcard and discussing the puppet with other onlookers.

2.3.1 Observations metrics

Event	Observed Intimate Encounters	Observed Engaged Spectators	Total Observed Spectators
Cheltenham Science Festival	45	150	195
Bristol Harbour Festival	40	240	280
Bristol Balloon Fiesta	45	130	175
Creative Technologies Network *			65
The Bristol Do	55	140	195
Arnolfini Science Café *			50
Totals	185	660	960

* Audience engagement at the Creative Technologies Network and Arnolfini Science Café differed from the walkabout encounters that took place at the festivals. At the Creative

Technologies Network, audience interactions took the form of listening to researchers' presentations about current research into social and emotional robots, accompanied by a demonstration of the puppet and followed by screenings of the documentary film. At the Arnolfini Science Café audience members took part in discussions with expert researchers about the whole area of social and emotional robots. These discussions were informed by their interactions with the puppet.

2.3.2 Audience interviews

Structured interviews using questionnaires took place at the festivals with people who had experienced a range of interactions with the puppet.

Event	Aged 12 and under		Aged over 12		Totals
	<i>Intimate Encounters</i>	<i>Engaged Spectators</i>	<i>Intimate Encounters</i>	<i>Engaged Spectators</i>	
Cheltenham Science Festival	3	1	4	5	13
Bristol Harbour Festival	2	0	7	6	15
Bristol Balloon Fiesta	4	1	8	5	18
The Bristol Do	3	2	8	5	18
Totals	12	4	27	21	64

There were also informal discussions with 6 audience members at the Creative Technologies Network and 6 at the Arnolfini Science Café. Their views are recorded in the Observations part of section 4 below.

2.3.3 Postcards

23 postcards were completed at the Arnolfini Science Café.

2.3.4 On-line Survey

Between 27 July and 31 December 2008, 436 respondents started the survey and 402 respondents answered all the questions.

2.3.5 Media Review

The analysis focused on 70 news articles published between 28 May and 2 October 2008.

2.3.6 Discussion event

12 members of the project team participated in this event. A further seven individuals, including participants in the film, provided feedback via phone or email.

3 Findings: Audiences

3.1 Audience Numbers

The intended and actual audience numbers are described in the following table.

	No. of events	Potential audience	Intimate Encounters	Engaged Spectators
Intended	7	25,200	2,180	8,200
Actual **	14	601,508	2,812	7,358

** Actual numbers achieved by 30 September 2008.

By 30 September 2008, the Heart Robot project had exceeded its target for potential audiences and intimate encounters and was on course to achieve its target for engaged spectators. In addition 4,105 postcards and 1,000 stickers had been handed out.

By the same date, the website (www.heartrobot.org.uk) had attracted 18,767 unique visitors. 301 had visited the site via www.heartrobot.info indicating they had used the address on the postcards. This represents 5.9% of the postcards and stickers that were handed out. It should be noted that visitors may have used the search term 'Heart Robot' to find the site even when they had been given a postcard or sticker, which means the number of visitors via heartrobot.info and the number of postcards or stickers cannot be directly correlated.

3.2 Observations

Observations were used to provide understanding of the audience members' engagement with a 'performance' of the puppet; to appreciate audience members' attitudes in context; and to define issues that could be followed-up in interviews. The observations also recorded numbers of 'intimate encounters' and 'engaged spectators' throughout each observation period. Observations were recorded in a structured 'field diary' which included sections for the number and type of participants; the level of their encounters; their input into discussions; the types of people who actively participated; the language they used; and their main areas of concern and questioning.

Analysis of the observational data involved tallies of audience numbers and categorisation of audience behaviours and comments.

The observations are described below:

3.2.1 The Puppet

- The puppet was intended to be innocent, vulnerable and slightly comical. It was a humanoid doll made of polymorph and c.70 cm tall. It had a large head, a large distended belly, long legs and large feet. Each hand had three fingers and a thumb. The body and the back of the head were covered in a padded suit made out of Egyptian cotton in a neutral colour. On the left side of the chest there was an exposed, contracting and expanding 'heart' which was back-lit with a red LED.

- The puppet had minimal facial features. It had two large eyes with moving eyelids, two nostrils and two ears which were turned slightly downwards. The eye-lids had 4 settings: asleep, sleepy, awake and startled.
- All of the joints were connected so that the puppet straightened up when held by the back of the head and underneath the buttocks. The behaviours of the puppet were animated by hand by the puppeteer. Manipulation by the puppeteer was clearly visible (there were no strings or rods), and the puppet was able to walk, dance and play.
- In addition, the puppet had a number of autonomous functions:
 - Accelerometers in the head and body were coupled to blinking and a beating heart. When the puppet was excited the rate of blinking and heart beat increased.
 - A proximity sensor in each of the puppet's hands meant that it could grasp an object or hold someone's hand.

3.2.2 General

- Even when 'unfinished' at Cheltenham Science Festival, Heart Robot managed successfully to engage adults and children. People of all ages were attracted 'directly' by the performance and 'indirectly' by observing other people (often children) who were interacting with the robot.
- Having a second presenter, often a volunteer, in addition to the puppeteer was vitally important. They could answer questions and explain aspects of the puppet and social and emotional robotics in general, thereby enabling the puppeteer to focus on audience engagement.
- Both the puppeteer and 'non-performing' presenters were able to answer audience concerns about the need for research into emotional robots by mentioning real-life situations, including healthcare, where such robots could be of benefit.
- Mention of the website documentary film had the effect of increasing audience interest in the website.
- The Heart Robot performance, despite being one of the quietest and least demonstrative activities at most festivals, managed to attract good audiences when compared to other louder, more demonstrative activities.
- People were overheard to repeat to friends and family what they had been told about Heart and emotional robots in general, which had the effect of increasing the 'indirect' audience and expanding the discussion.
- Some audience members held the puppet, taking over from the puppeteer. They were also overheard to be explaining its features. It was noticeable that some individuals were more likely to approach the puppet when it was being held by someone from the audience. It was as if the 'handing over' meant permission had been granted for them to interact.

3.2.3 Audience Encounters

- The performance, which deliberately incorporated playful elements, was able to provide audiences with a wide range of highly-personalised engagement experiences:
 - 'Contact' intimate encounters – many children and adults automatically wanted to touch the puppet.
 - 'Non-contact' intimate encounters – children in particular were able to have intimate encounters without touching the puppet. These included mimicking tits movements; and 'dancing', 'walking' or 'playing' with it.
 - Engaged spectators – these could be attracted from a wide distance (up to 10 metres in some cases). Several people were observed making detours to watch or photograph 'intimate encounters'.
- A typical intimate encounter lasted between 2 and 3 minutes. The ratio of intimate encounters to engaged spectators varied between 1:3 and 1:6 according to the nature of the event and the location.
- The nature of the engagement experiences did not appear to affect the responses or reactions of audiences, which were consistent regardless of the type of encounter.
- Overall, the majority of observed encounters (c.60-65%) took place with females, which is generally thought to be atypical for robotics activities, but may be typical of the events attended. Most of the audiences at the festivals were family groups, reflecting the nature of these events.
- The audiences at the Arnolfini Science Café and Creative Technologies Network consisted only of adults. At the Creative Technologies Network, there was no performance and audience members did not choose to interact with the puppet. In contrast, there was a performance at the Science Café where audience reactions mirrored those seen at the festivals.

3.2.4 Audience Reactions

- Most interactions began with a playful encounter with the puppet. Despite this, there was some degree of uncertainty or caution amongst several audience members when they first saw the puppet. Adults were more likely than children to demonstrate this behaviour. Extreme examples included adults being reluctant to handle or touch the puppet or children peering at it from around their parents' legs. In almost all cases initial caution was overcome by the puppet's 'cuteness' and visual appeal, resulting in them 'playing' with it. As a consequence the performance managed successfully to entrance both adults and children.
- Audience reactions covered a wide spectrum from 'scary' to 'brilliant'. One of the most common audience reactions was 'weird but cute' or 'strangely endearing', perhaps reflecting the initial caution described above. Other words that were overheard repeatedly were 'amazing', 'cuddly', 'lush', 'scary', 'strange'.
- Adults made comments about the puppet looking like a 'baby' or 'burns victim'. Most people referred to the puppet as male.
- Children and adults wanted to know the puppet's name. Often, children and adults were overheard discussing where they might buy one.

- Roboticists and non-specialists were in two camps. They either loved the puppet unequivocally or were taken by it but also thought it a bit weird or frightening looking. Concerns or negative comments related mainly to its appearance e.g. ‘scary flashing eyes’, ‘weird bandages’.
- Despite the generally positive reactions, a small number of adults and fewer children were overheard expressing concern about the wider concept of emotional robots and their possible negative impact on society. The main concern appeared to be about robots ‘taking control’ or ‘taking over’.
- Representatives from creative companies indicated that they thought Heart Robot would make interesting TV viewing.
- Adults were of the widespread opinion that the puppeteer was crucial to the success of Heart Robot. They felt that it would be difficult for other robotics researchers to replicate what was happening with Heart.
- Some adults, including roboticists, said that Heart was not a robot, because its reactions were controlled by puppetry. Several people said it was a robot-puppet hybrid.
- Many adults wanted to know where and how the Heart Robot project would continue. A commonly expressed view was the need to continue public dialogue about social robots.
- Children were most likely to ‘challenge’ the puppet. For example, one boy hit the puppet on the face and poked it in the eye. When asked why, he said he liked the puppet and just wanted to see what it would do, i.e. how it would react?

3.2.5 Media references

- Widespread media coverage of the project occurred just prior to the Harbour Festival and Balloon Fiesta. Audience members at these and later events were overheard to say they had seen the puppet on television programmes or in newspapers. Most people who made these comments were aged 30 or over, reflecting the fact that the robot had appeared in news media.
- There was some evidence that the media coverage had conferred Heart Robot with “celebrity” status. People were overheard saying they wanted to be photographed with it and how it was good to have an opportunity to see it themselves. Another commonly overheard reaction was “local pride” that it had been developed in Bristol.

3.2.6 Responses to the Film Screening at the Creative Technologies Network

- The film was introduced as a personal artistic record and not an official documentary record of the project.
- Members of the public enjoyed the film, with several saying it seemed much shorter than the advertised 25 minutes. A few said it changed pace about two thirds of the way through, becoming somewhat repetitive.

- Some robotics researchers were concerned that the film was unbalanced i.e. did not contain enough positive views about the potential for emotional robots. Non-roboticists did not express this view, with several indicating that a positive view was demonstrated by the reactions of the public, which they thought contradicted some of what was said by the robotics researchers.
- A number of people wanted the film to include interviews with the public and several would like to have seen more footage of interaction between adults and the puppet.
- It was suggested that a psychologist specialising in human-machine interaction would have been a very interesting subject for interview and could have provided a counterpoint to (or confirmed) the opinions expressed by the robotics researchers and the public.

3.3 Audience Interviews

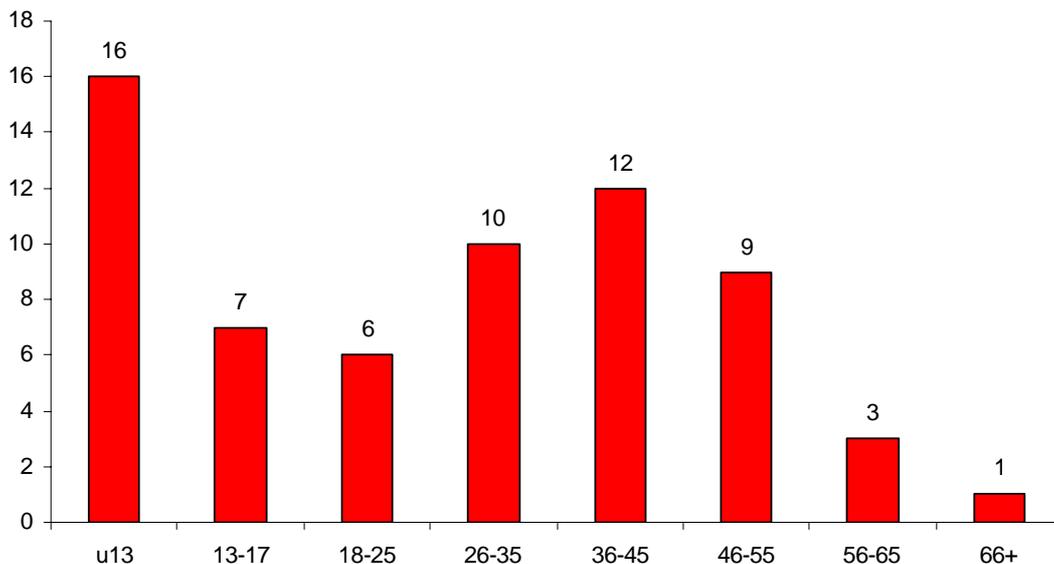
Face-to-face interviews were conducted using one of two questionnaires (one for those aged 12 and under and those aged over 12) comprising a mixture of closed and open questions. The closed questions provided demographic information; data about general attitudes towards robots and ratings of Heart Robot. The open questions enabled audience members to express a wide range of opinions such as why they did or did not like the puppet; what they liked or disliked; the believability and usefulness of emotional robots.

Responses to closed questions were entered into an Excel spreadsheet and added together. For each open question a 'coding framework' was devised to allow similar responses from different people to be added together. The coded responses were entered into an Excel spreadsheet for analysis.

3.3.1 Demographics

The age ranges and gender balance for interview subjects are presented in the graphs below.

Respondent age ranges n=64



The age ranges reflect the family audiences that are most likely to attend the festival-type events where performances took place. Females made up 62% (n. 40) of the subjects, which corresponds to the gender balance that was observed interacting with the puppet.

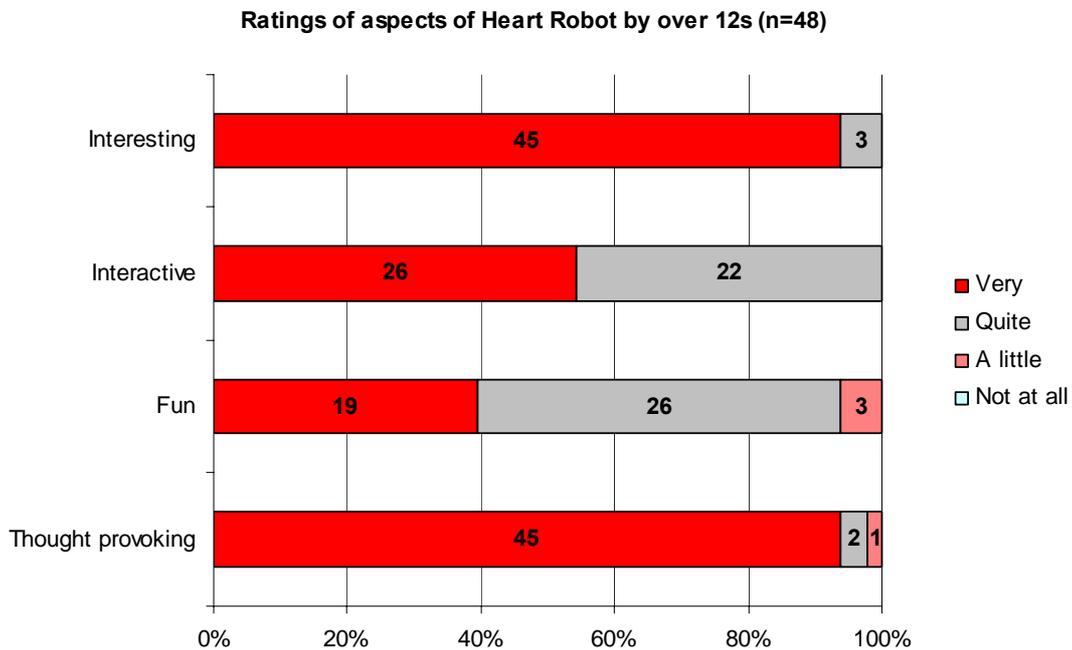
3.3.2 Descriptions of Heart Robot

Subjects aged over 12 (n=48) were asked for a maximum of three words that best described Heart Robot to them. The top ten most-used words are listed here in decreasing order of the frequency with which they were mentioned.

- Interesting
- Weird
- Amazing
- Thought-provoking
- Engaging
- Fascinating
- Surreal
- Cute
- Lifelike
- Lovable

3.3.3 Opinions of Heart Robot (over 12s)

Subjects aged over 12 were asked to rate different aspects of Heart Robot. They generally responded positively.



Nearly all subjects aged over 12 responded that the puppet was 'very' interesting and 'very' thought provoking. Over 90% responded that it was 'quite' or 'very' interactive and 'very' or 'quite' fun. These responses indicate that the puppet was successful at entertaining audiences as well as stimulating interest in the subject of social and emotional robots.

Reasons given for these responses included:

It is so different to anything else I have ever seen.

My 2 year old grandson was not at all scared by it. If you'd asked me before I'd have said he would be.

I saw it on TV and wanted to find out more. This is a great opportunity to see it for real.

I am interested in Artificial Intelligence, which is why I found it interesting.

I would like to have one myself. Holding it was fantastic and somehow soothing.

It is quite weird but really attracts people.

It's great that it has been developed in Bristol. It was cool to see it on TV.

I enjoy science and learning about it. This is part of that.

I would love one, I really liked how it responded when I touched it.

It appeals to everyone.

They are doing a great job communicating to the public about a difficult subject.

I want one, just to hold. It would be a great stress reliever

It is cute.

It's a great idea. Where did the idea come from?

It's made me wonder what would happen if we all had one. Would this be good or bad? I don't know

I care for adults with learning difficulties. I think it could be very useful therapy for them or with autistic children.

I don't usually like science but this is different. It is really interesting and makes you think.

Very professionally done and presented.

3.3.4 Opinions of Heart Robot (12 or under)

Subjects aged 12 or under (n=16) were asked to rate Heart Robot as good average or bad. The majority (81%, 13) rated the robot as 'good', with the remainder indicating that they thought it was 'average' and no one rating it as 'bad'.

Reasons given for these responses included:

Good - *I think it is really, really clever.*

It was very interesting.

It was great! I liked the robot.

I thought it was really good and interesting.

It was interesting because I had never heard of this type of robot

I would like to have one.

The man was really good at explaining it had sensors and things which reacted to you.

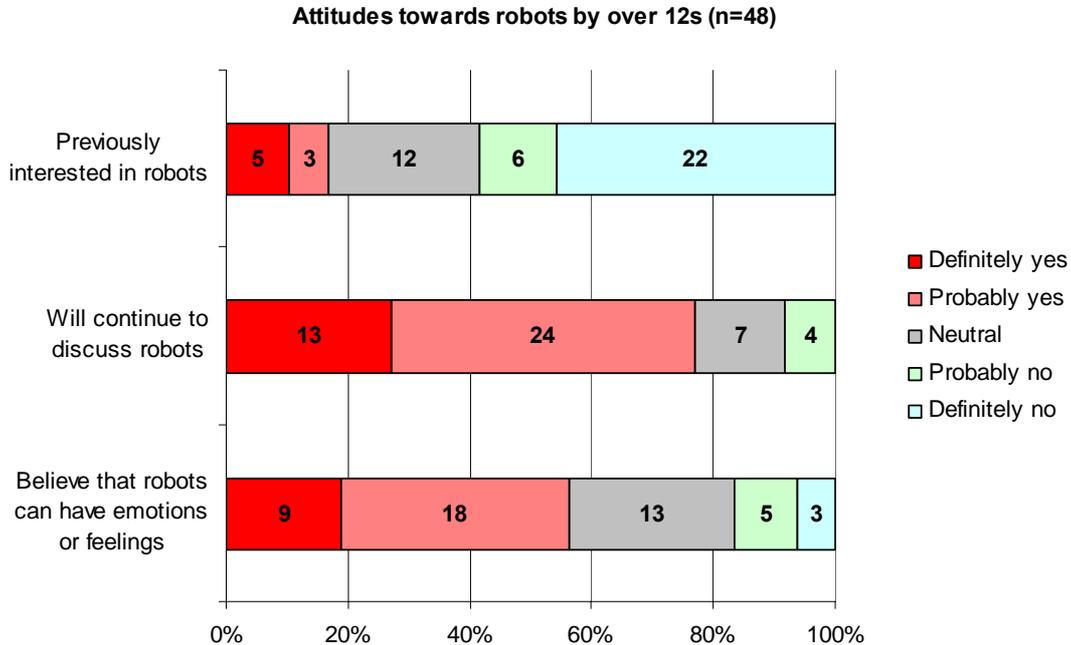
Average- *Its heart beating faster was very good, but a bit strange.*

I like robots anyway. This one held your hand which was amazing.

It was quite interesting and fun.

3.3.5 Attitudes towards robots (over 12s)

Subjects aged over 12 were asked whether they believe that robots can have emotions or feelings, about their previous interest in robots, and the likelihood that they would continue to discuss robots



58.3% (28) of subjects aged over 12 indicated that they were ‘definitely’ or ‘probably’ not interested in robots prior to seeing Heart Robot. However, 77.1% (37) indicated that they would continue to discuss robots after having seen Heart Robot. These responses imply that the puppet has increased audience members’ interest in the subject of robots or provided them with information that they intend to share with others. Over 50% of subjects indicated that they ‘definitely’ or ‘probably’ believe that robots can have emotions or feelings. A number of subjects across all answer categories (20, 41.7% of the total aged over 12) said that robots emotions or feelings are given to them by man, either through programming or some other form of influence or control.

3.3.6 Impact of Heart Robot (over 12s)

Subjects were asked if Heart Robot had changed their feelings about robots and the reasons for any change.

83% (40) of subjects aged over 12 indicated that Heart had changed how they feel about robots. Most of the reasons given for the changes referred to Heart’s ‘emotional’ attributes or its differences from most common public perceptions of robots. Examples are given below:

It shows that some robots can have feelings.

It does not look or feel like a robot, which I like.

It made me realise that the robots shown in films are not the only type that exist.

It made me realise that all robots are different

I liked the way it responded to your touch, it made it more interesting than most robots

I did not know that robots could be like this. They normally appear hard and unfriendly -

not this one!

It has life. It's got a heart, which makes it different from other robots.

It is scary until you realise it is a robot.

The fact that people can make something like this. They have proven what is possible with robots, and done it locally!

I liked its character. Giving it character made it more interesting

Before today I would not have believed that robots could have emotions.

The subjects who said that Heart Robot had not changed their views often referred to robots as machines. Their comments included:

It was entertaining but not changed my thoughts.

I still believe robots are just machines. Any emotions they have are given to them by man.

I still believe that we are giving emotions to machines. They cannot generate feelings without our intervention.

Robots cannot display emotions unless we give them those emotions. It is man who creates emotions and feelings not machines.

3.3.7 Impact of Heart Robot (12 or under)

Those aged 12 or under were also asked if Heart Robot had made them more or less interested or not changed their feelings about robots and the reasons for any change. 81% (13) indicated that it made them more interested in robots with the remainder selecting 'no change'. No one responded that Heart had made them less interested.

Everyone who responded 'no change' said it was because they already liked robots. Examples of the reasons given for increased interest included:

I did not know that robots could be like this, i.e. change when people did different things.

I thought it was a puppet at first. Finding out it was a robot made me realise that not all robots look the same.

I thought it was brill. I never knew that you could have robots like this.

I like a robot that responds to you.

Brilliant. State of the art. It could be put to brilliant use.

I'd really like to own one and see all the things it could do.

It's good because there are lots of things this robot could do that other robots I've seen could not.

I want one – it would be really cool.

3.3.8 Other comments and opinions

In the final section of the interview, subjects of all ages were invited to add further comments or suggest improvements to Heart Robot. Several themes were identified in their responses.

Many subjects took the opportunity to suggest 'improvements' to the **puppet's appearance**. Most of their comments referred to making it look more attractive and less scary or less like it was wearing bandages:

Make it look more like a baby as some people are scared of the way it looks now.

I think it should be a brighter colour and that it should respond to voices and sounds. It could even be given its own voice.

Coloured clothes would make it look less like it was wearing bandages.

It would be interesting to see people's responses if it looked less like a 'bandaged' victim.

Make it more brightly coloured. The bandages make it look injured. It would be better if they were not white.

Other respondents made comments about the **potential impact on society of emotional robots**. Negative and positive impacts were mentioned:

It could be useful for society, in healthcare. I'm going on the website to find out more.

I would love someone to investigate if it could help people with learning difficulties.

I am concerned that it would mess with people perceptions of what is a machine and what is human.

I think the face is the thing that attracts people first, which makes me think that subconsciously we believe it is human. I am not sure if that is a good thing. Surely we need to retain our belief that it is a machine.

There were also expressions of pleasure and pride that the puppet had been **created locally**.

I'd love to know where the idea came from. It's really good that it came from Bristol and not somewhere like America, which is what you would expect.

It's so cool that he's from Bristol.

It's amazing that this was made here. He should have a Bristol t-shirt on.

Many respondents said 'keep doing it' and expressed their view of the **importance of public engagement activities** such as this. Their comments included:

Keep doing it, keep it interactive.

Just continue to allow people to see it for themselves, particularly children.

Take it to At-Bristol and schools to let more children see it.

People of all ages indicated that they want to **own a similar robot**. There was some indication that they expected Heart Robot to become mass produced:

My wife and daughters would like to own one. I think it probably is not a man thing. It appeals more to women than usual robots.

I'd like to own one, just to handle it daily would be interesting and enjoyable.

I want one – It's so cool.

Where can I buy one?

3.4 Audience Postcards

Audience members at the Arnolfini Science Café were invited to write their thoughts and questions about Heart Robot on postcards. Their inputs were categorised as follows:

Appearance

- *In making the Heart Robot you have created a robot that invites love and protection. Did you deliberately decide to make a 'baby' to evoke these feelings? A baby that can be passed around and sits close to humans. Were the shape to be a robot in armour (for example) one would not respond the same. Nor presumably would the robot – or would it?*
- *What is the point of making robots in the human image?*
- *Why is it so soppy looking? Is it just a toy for grown-ups? Would not a rag doll produce the same emotions? Tenderness in young women bringing out the maternal instincts. The floppy head, big eyes, lolling body. The fact it can't answer back*
- *Does Heart come in black? What has been the response from different ethnic groups?*

Rules and Rights for Robots

- *Should we now consider the 'Ten Rules for Robots'? Rule 1 – A Robot shall never hurt a human.*
- *Rights for Robots! At what point will robots want their rights?*
- *Will an artificial life ever realise that they could be a superior race? How will this be regulated?*

Robot Love and Hate

- *Axiom: Human love is unpredictable. Query: would robot love become unpredictable? If so, does that still define love in traditional human terms?*
- *Biggest problem is semantics. Does my DOG really 'love' me – or do I impose my own interpretation on ambiguous behaviour? Dogs are often claimed to 'smile' which they are physiologically incapable of doing.*
- *Can a robot ever hate you? Will it feel terror from your control over its awareness?*
- *You asked the question 'can a robot love someone?' But what is the answer? Can a robot think a person loves them?*
- *What would be the impact of loving a robot? Computer 'games' elicit feelings of aggression which, some feel, distort human-human interactions. Could robots that elicit human-human interactions also distort human-human relationships?*
- *The title of the talk is 'Could we ever love a robot'. Maybe it should be 'Should we ever love a robot'.*
- *You asked can robots ever love humans? So – can robots even possess consciousness?*
- *Robots will never have a soul as such so will never have human emotions such as jealousy, hate, love, kindness etc. The human soul is infinitely variable and this you will never replicate electronically.*

Test for Robot Love

- *Could a robot really love a human being? Perhaps this could be framed as some kind of emotional Turing test. If the robot exhibits behaviours which a human being experiences as love then, in some sense, the robot does love the human being.*
- *How will we know if we HAVE made a robot that can love us? Is there any equivalent to the Turing test?*

Using Emotional Robots

- *If you can model humans accurately could you model a virtual stock market?*

- *What about the workers? Skilled mechanics train their assistants and so on, what comes next if robots become the assistants?*
- *Have you tried the heart robot with autistic children?*

General

- *If the human brain could be mapped in respect to all reactions, could a robot be programmed to react as a human does?*
- *How do YOU see the future of AI in the UK?*
- *Have you seen Bicentennial Man with Robin Williams?*

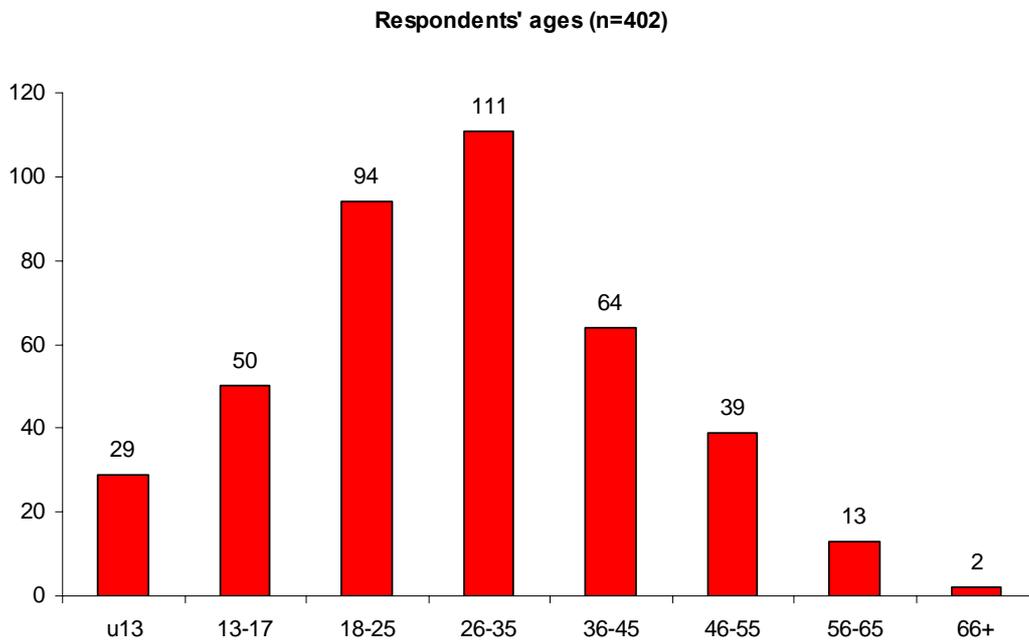
3.5 On-line Survey

The Heart Robot website enabled members of the public to follow-up their interest in the puppet. Visitor impressions about both the puppet and the website were gathered through a voluntary on-line questionnaire survey. The questionnaire comprised three parts: information about respondents; their opinions about robots in general and Heart Robot specifically; and their views about the website. Space was included for respondents to make general comments.

Responses to closed questions were entered into an Excel spreadsheet and added together. For each open question a ‘coding framework’ was devised to allow similar responses from different people to be added together. The coded responses were entered into an Excel spreadsheet for analysis.

3.5.1 Respondents’ demographics

The age ranges of survey respondents are presented in the following graph.

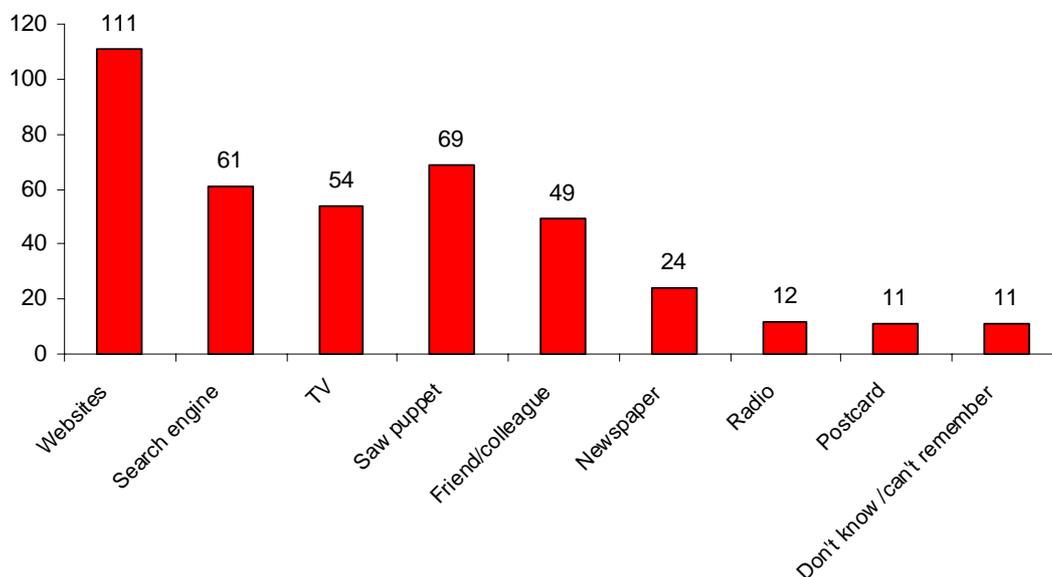


51% (205) of respondents were aged between 18 and 35 and 70.7% (284) were aged 35 or less. Females made up 62.2% (250) of respondents, which was consistent with the gender balance observed and interviewed at the events.

3.5.2 How survey respondents heard about the website

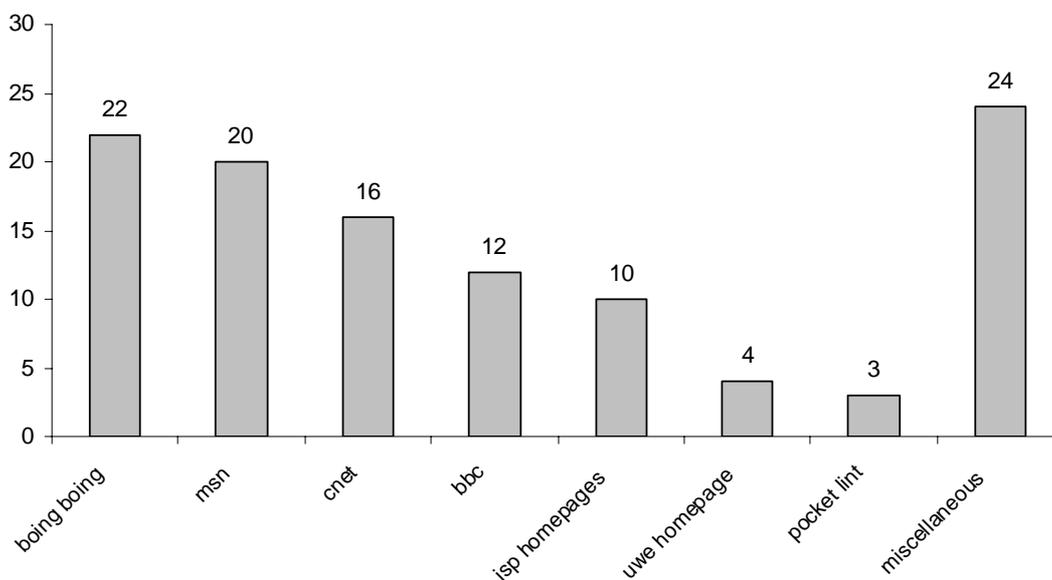
The ways in which respondents heard about the Heart Robot website are presented in the graphs below.

How respondents heard about the Heart Robot website (n=402)



The most common response (27.6%, 111) was 'other websites' (i.e. non-Heart Robot websites), followed by 'saw puppet' (17.2%, 69).

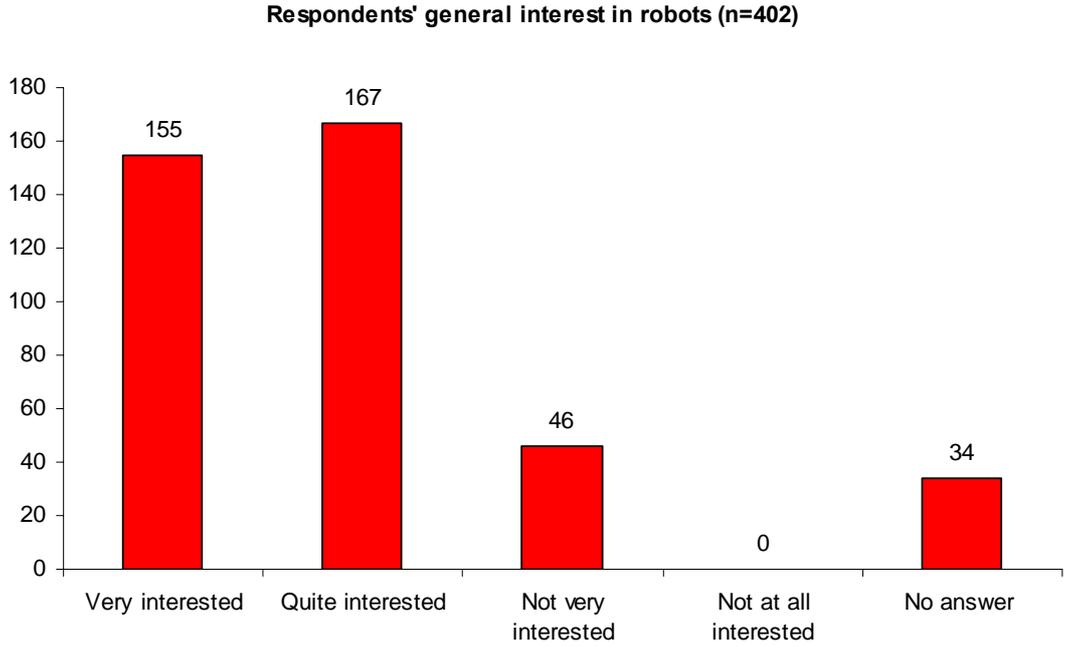
Webpages used by respondents to find out about the Heart Robot site (n =111)



Of the other websites used to find the Heart Robot site 'boingboing' was mentioned by 22 respondents and 'msn' by 20. The miscellaneous category included 10 non-UK news web pages.

3.5.3 Respondents' interest in robots

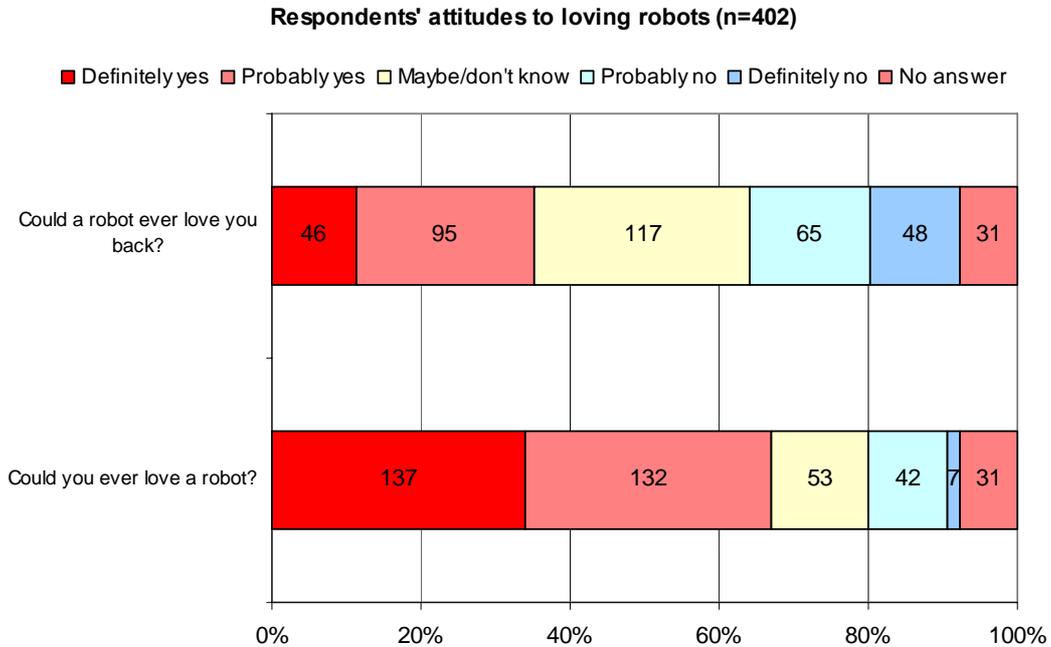
Respondents were asked to rate their interest in robots.



80.1% (322) of respondents said they were 'very' or 'quite' interested in robots and none were 'not at all' interested.

3.5.4 Respondents' attitudes towards robots

Respondents were asked if they could ever love a robot and if a robot could ever love them back.



66.9% (269) of respondents indicated that they could 'probably' or 'definitely' love a robot compared to 12.2% (49) who said they 'probably' or 'definitely' could not. The responses for whether or not a robot could 'love you back' was less certain, with 35.1% (141) responding 'probably' or 'definitely' positively and 28.1% (113) responding 'probably' or

'definitely' negatively. A further 29.1% (117) were uncertain that a robot could love them back, which contrasts with 13.1% (53) who were uncertain that they could love a robot.

3.5.5 Respondents opinions about emotional robots in the future

Survey respondents were asked how they thought robots with emotions or feelings could affect society and our lives in the future. 369 respondents answered this question. Several themes were identified in their responses.

70.5% (260) of the respondents who answered this question remarked positively about emotional robots. 18.4% (68) made **general comments that were positive**, such as those listed below:

I think they can affect us in a positive way.

It will definitely make a positive change in the lives of people and children.

I think they can help bring us together.

I would love to think this can make us better humans.

They can make us happy when we are sad.

A further 52.1% of respondents (192) were positive in that they **identified specific applications** for emotional robots. Of these, 30.5% (112) said that the robots could be used for emotional support or companionship; 16.0% (59) described medical or therapeutic uses, including help for people with Alzheimer's, autism or ADHD; and 5.8% (21) said that social robots, including the Heart Robot puppet, should be sold as toys. Examples of their answers included:

If they were all like heart, who I found adorable, I think it would help combat loneliness because they would make a wonderful companion for somebody on their own.

Maybe we can use them as "trainers" to develop our emotional side.

I feel that they could help with loneliness. I know a lot of women that can not have children who would love something like this; it would not matter if it loved back. All that matters is that it something to love.

They could help very young children with confidence problems because they could learn to interact with the robot which would help them to get on with other children with similar emotions to the robot.

These robots have the potential to help others. They can be used in therapeutic ways. They can be used to help children battling cancer. They can help with the treatment of autism, as well as treating children who have experienced previous traumas.

They could reduce stress for some people and help people with ADHD and autism. The robots would help them feel better when with other people.

I see a definite use with special needs children, especially Autistic spectrum children and Asperger's children such as my son.

I think they could make great toys which would teach children how to take care of something special without giving them the full responsibility of caring for an animal.

The robots could do jobs for us. If a child or anybody was in hospital the robot could look after them and cheer them up.

Having worked as a health visitor for most of my career I wonder if in the area of promoting parenting skills Heart could be a non threatening way of encouraging communicating without fear of rejection or of failure. Young parents, often just out of school, don't always have these skills.

I am at present looking for a doll for my Mum who has Alzheimer's. She is not able to engage with usual everyday activities any more and I am hoping that on an instinctive level she might respond to a doll as something she could look after. Maybe a Heart Robot would be even better?

Concerns about the possible impact of social and emotional robots were expressed by 11.6% of respondents (43). Some of their comments indicated that they were concerned by confusion that could arise from people 'loving' robots and others believed that robots could somehow turn against their creators.

They would make the future even more weird and strange than it is going to be.

I think there's the danger of people relying on robots to meet emotional needs in the same way that people sometimes rely too heavily on pets or internet communication to feel connected. This can be a substitute for real, human connection.

I think they might make us a bit confused about what love actually is for!

Could be dangerous for us, not knowing what is true love and what is simulated love. Perhaps some might not think there is a difference if both cause the same physiological conditions in the brain, but maybe in 200 years, we could lose our soul.

Instead of racing towards the future maybe we should sort out the mess we're in now before we make it worse. Why do machines need to feel? What is the purpose of these robots when we have each other to reciprocate love? Risky risky risky business...

It's kind of scary because I think that humans will just take advantage of robots, even while they evolve, and eventually they will turn on us. This is hundreds of years down the road, but definitely possible.

Man will not stop creating new, more sophisticated robots until AI is a reality! Hope we are not at war with the results someday!

17.9% of respondents (66) were **uncertain** about whether the impact of social and emotional robots would be positive or negative. Their responses either expressed uncertainty or contained both positive and negative elements

I am quite uncertain about how they could affect us. I could imagine a child who has to live in a bubble because of an immune condition having one to play with. However I am concerned by the thought that they could become substitutes for human contact with older people, for example.

At this point I do not know enough of the aspects of interaction the Robots will have with us. I am interested, though, to see if it will be in fact, beneficial to humans.

I think they might help people with loneliness a little bit. But they can't ever be a complete substitute for human interaction, no matter how sophisticated they could become.

I believe that being able to "use" a "toy" like this would be great fun. I am looking forward. But I am a little afraid of it, too. For me, and most of all other people, it wouldn't be dangerous to be "a robot's friend", but I do believe that it could be dangerous for the social life of some.

For me I can see the immediate stimulus/response thing happening and doing so both ways (human to robot and back again). Warm and comforting yes but is that love? I'm not so sure.

3.5.6 Likelihood of revisiting the website

Survey respondents were asked how likely they were to return to the Heart Robot website.

78.6% of respondents (316) indicated that they were 'very' or 'quite' likely to return. 35% of respondents (141) gave a reason for their answer. The most common responses for those who answered 'very' or 'quite' likely were updates on the project's progress and to find out where Heart Robot would be appearing. These were followed by general interest in the subject of robotics. 4.5% of respondents (18) indicated that they would return specifically to find out how they could own or buy Heart Robot.

Those who said they were unlikely to return indicated it was because they already had all the information they wanted or needed.

3.6 Media Coverage

The appearance of the puppet at the London Science Museum's Interactive Emotibots exhibition in late July 2008 attracted considerable media interest. On 5 September 2008, 'PR Week' reported the outcomes of the media campaign carried out on behalf of the Science Museum to launch the exhibition. The report stated that campaign generated more than 200 news pieces in national and regional newspapers and on TV and Radio. It referred to pieces on BBC Radio 4 Today Programme, BBC Radio Five Live, ITV News, BBC News 24, Richard and Judy and Good Morning America and Fox News in the USA. It also cited a column in the 'Independent on Sunday' which compared Heart Robot to Gordon Brown's reaction to David Miliband's leadership challenge.

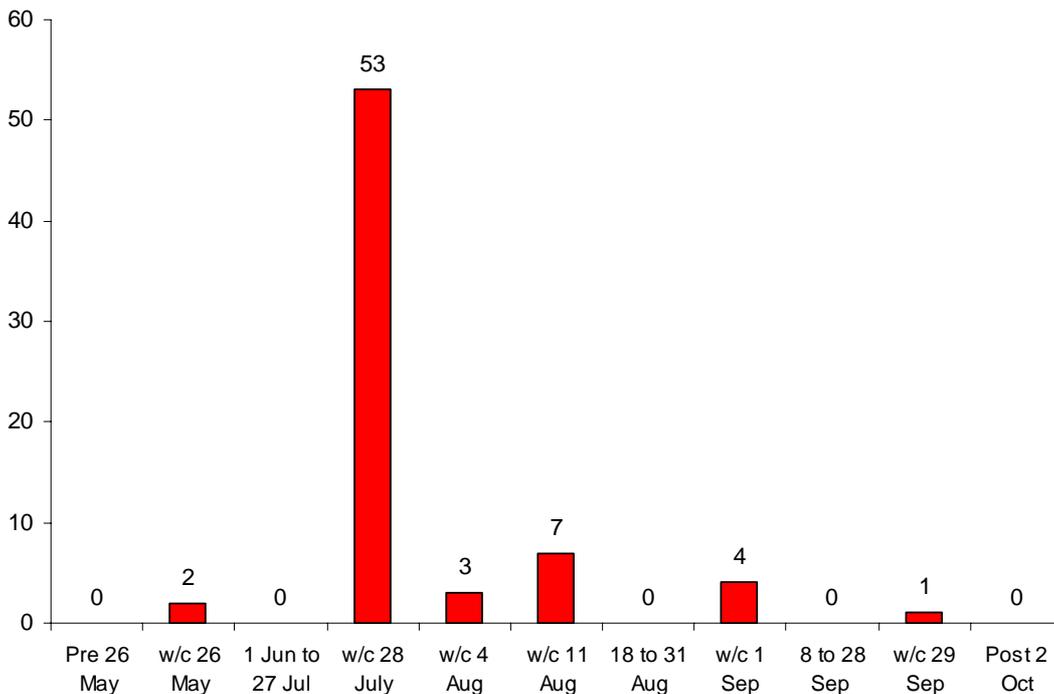
A search on Lexis UK revealed 70 articles about the Heart Robot project from national and regional newspapers worldwide during the period 28 May to 31 December 2008. In addition, there were 2,100 blog references and over 5,000 hits on Google that were related to the project.

The articles identified in the Lexis UK search are analysed in this section of the report. The blogs and other new media references will be analysed as part of a dissertation for an MSc in Science Communication to be published later in 2009.

3.6.1 Publication Dates

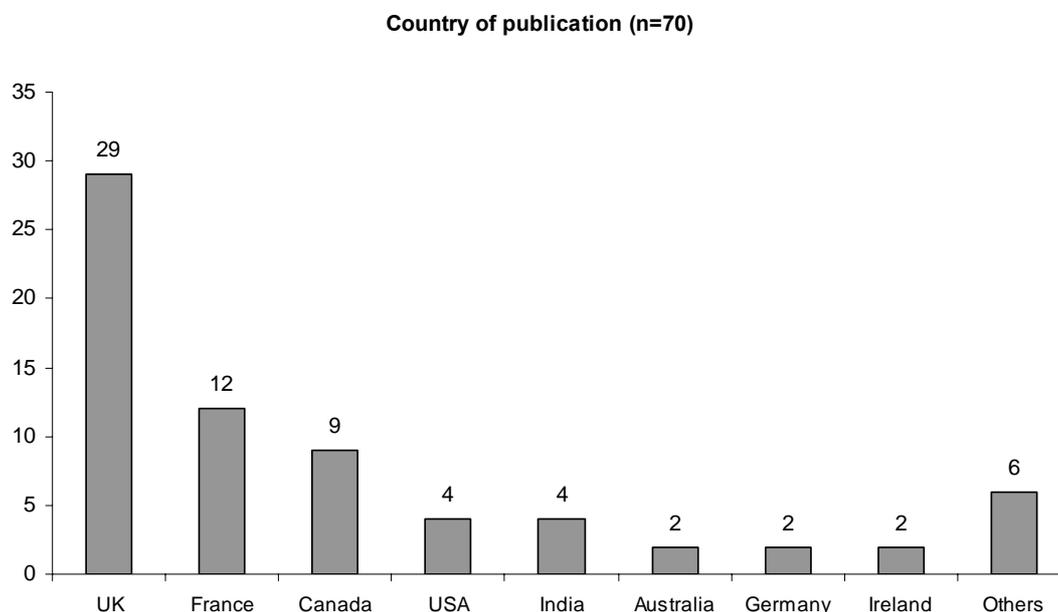
In late May 2008, 2 articles (2.9% of the total) reporting the launch of the project were published in local Bristol newspapers. 53 articles (75.7%) reporting the puppet's appearance at the Science Museum Emotibots exhibition were published between 29 July and 3 August. Coverage continued until 2 October 2008. It is worth noting that the exhibition coincided with the launch in the UK of the film 'Wall:E' about a machine with human characteristics, which provided a hook to attract media interest and was referenced in the Museum's press release.

Publication dates of Heart Robot articles (n=70)

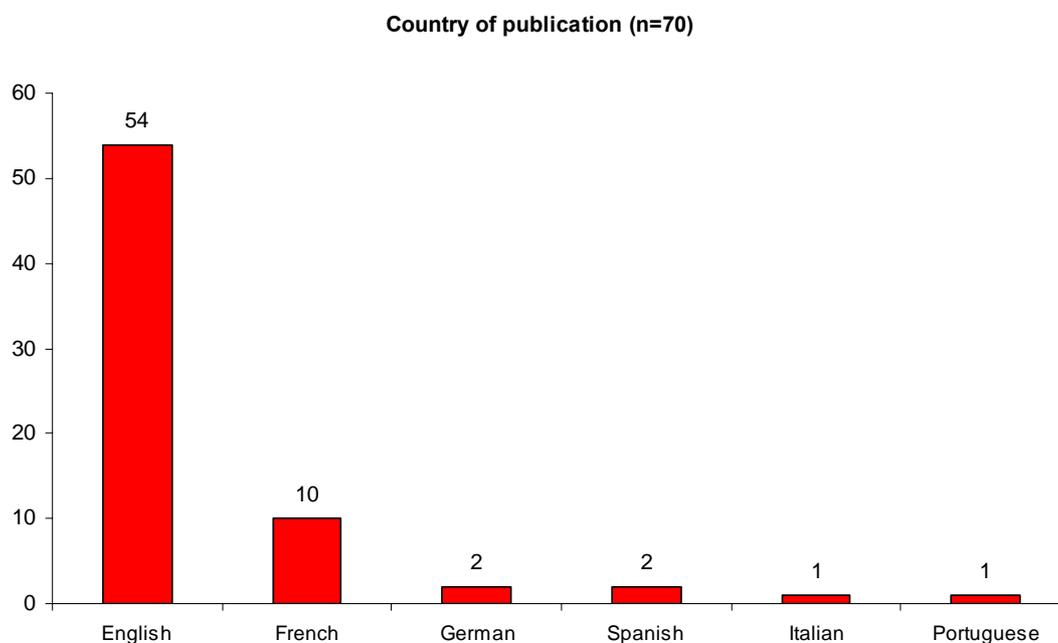


3.6.2 Geography and Language

The 70 articles were published in 13 countries. The UK led the way with 29 articles (41.4%) followed by France (12, 17.1%) and Canada (9, 12.9%). Other countries where more than one article on Heart Robot was published were USA, India, Australia, Germany and Ireland. One article was published in each of Italy, Luxembourg, Mexico, Portugal, Spain and Uruguay.

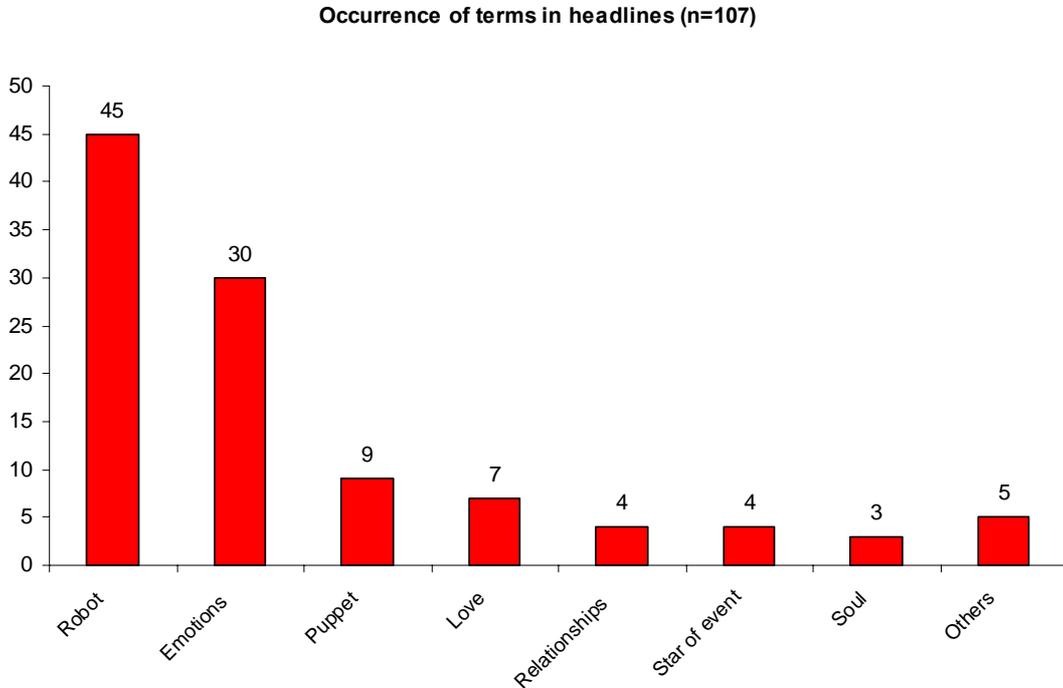


Articles were published in 6 languages. Not surprisingly, English was the most common (54, 77.1%). It was followed by French (10, 14.3%). The other languages were German, Spanish, Italian and Portuguese.



3.6.3 Headlines

The word that appeared most frequently in the articles' headlines was 'robot' (45 occurrences), followed by 'emotions' (30). Other words or phrases to appear in headlines were 'puppet' (9), 'love' (7), 'relationships' (4) and 'star of event' (4). Some headlines included more than one of the terms listed in the following graph, which explains why n=107.



3.6.4 Nature of Articles

The majority of major news articles did not report Heart Robot in a negative light. Most articles (56, 80.0%) were balanced factual reports. The majority of these contained quotes from a member of staff at the Science Museum and appeared to have been taken directly from the Museum's press release for the launch of the Emotibots exhibition. All of them referenced Heart Robot and the Hexapod robot and in every case except one Heart Robot dominated the article. There were some inaccuracies in these pieces, for example some reported that Heart Robot had been developed by Science Museum staff and another said it was created specifically for the exhibition.

Heart Robot was also mentioned in 6 (8.6%) technology or gadget round-up or summary pieces. The references to Heart Robot in these articles alongside the latest releases in computer or digital recording technologies may have enhanced the belief that people could buy one.

There were also 5 (7.1%) opinion pieces. Of these, 3 commented positively about emotional robots and 2 were more negative in tone. The three that commented positively emphasised the potential applications of social robots in healthcare and care of the elderly. One of the negative articles was warning of the threat of 'killer robots'. It cited Heart Robot as a machine designed specifically to be put into care homes to interact with the elderly. The other questioned whether a robot with Heart's appearance, which it described as 'looking terminally ill', could be useful in healthcare rehabilitation.

Heart Robot also provoked comment in 3 (4.3%) political pieces – two in the UK and one in the USA – that drew comparisons between Heart Robot and political figures.

3.6.5 Descriptions of Heart Robot

Articles used a variety of descriptions for Heart Robot other than robot, puppet or robot puppet. Common alternative descriptions were 'baby' and 'Gollum'. The most frequently used of these was 'Gollum', which is not surprising as the Science Museum press release quoted a member of staff as saying the puppet looked like 'a cross between ET and Gollum'. The most provocative descriptions were 'anaemic leprechaun' and 'love child of a monkey and an i-mac'.

3.6.6 Other media

Whilst this report does not include a detailed study of coverage in other media such as TV and Blogs, an initial perusal of both indicates that their reporting may have been less accurate than the mainstream news media. E.g. TV news in the USA gave the impression that Heart was available to own and described it as 'less useful than a roomba'.

4 Findings: Project Team and Researchers

A discussion event on 29 October involved 12 members of the project team. In addition to the Primary Investigator, Co-investigator and Project Manager/Puppeteer, paid and volunteer members of the engineering and creative communities that participated in the project were also present. Other contributors and researchers also provided feedback via email and telephone. In the case of the researchers their feedback focused on the film and is reported separately. The project team's discussions identified a number of successes, challenges, opportunities and lessons.

4.1 Successes

4.1.1 Project Activities and Processes

- The calibre of the experts who agreed to participate in the project. Many of them are world-renowned in their fields.
- The amount of goodwill that the project attracted amongst experts in the fields of robotics and performance.
- High levels of commitment from the project team, including volunteers, enabled tight timescales to be met and a highly ambitious project to be delivered successfully.
- The project team was sufficiently flexible to find new dates and more events in order to achieve the targets.
- The use of unpaid volunteers created the resources needed to achieve the planned outcomes and also allowed the project to be delivered within budget.

4.1.2 Audience Engagement

- The project demonstrated what can be achieved using mechanisms that are novel to public engagement in the science communication context, but commonplace amongst artistic performers.
- The performance successfully engaged audiences in both conventional (e.g. science festival) and non-conventional (e.g. street festival) environments.
- Successful engagement was achieved with a puppet that had fewer functions than were planned originally.

- The puppet did not need an introduction – skilled puppetry and its interesting appearance automatically attracted audiences.
- Media coverage hugely exceeded expectations. The puppet's visual appeal and 'cuteness' probably opened doors in this regard.
- The hand crafted look and 'simplicity' of the puppet had universal appeal and provided a hook to a wide cross-section of the public.
- The fact that audience members were able to handle and hold the puppet should have helped them to remember the experience.

4.1.3 Impacts

- Impact was greater than anticipated in terms of overall numbers of the public that were reached. The project also exceeded its target number of direct engagements.
- The project's wider impact hugely exceeded expectations due to the scale of mainstream media coverage.
- The puppet's appearance and its ability to attract people not previously interested in robots enabled some of the clichés about robots to be dispelled e.g. that all robots are expressionless machines.
- Encounters resulted in discussions about social robots both amongst audience members and between audiences and the project team.
- The variety of locations and nature of the delivery reached audiences that would not usually attend science events.
- Members of the project team heard directly from the public their suggestions for possible uses of social and emotional robots.
- The experience was very satisfying for participants. Those members of the team and collaborators who were able to see the puppet in the field found the experience extremely rewarding.
- Many collaborators and members of the team reported that they had learnt new skills.
- Researchers who observed the performance at first hand learnt that there alternative forms of public engagement to standing in a booth at a science festival.

4.2 Challenges

4.2.1 Project Activities and Processes

- The puppeteer was also the project manager, designer and puppet-builder which resulted in excessive and unrealistic demands on one individual's time and impacted adversely on project management.
- Objectives and boundaries were not always clearly defined or communicated consistently, thus leading to some confusion for collaborators and other members of the team.
- Timescales for design and development were very challenging. The funding was awarded in April and the first pilot delivery date was scheduled for end of May.
- The completion dates for the website and documentary were continually shifting as the puppet was being prepared.

- It was sometimes difficult for members of the team to accept the reduced functionality of the puppet.
- The puppetry performance was very tiring for the puppeteer, meaning that the planned day-long performances were not physically possible.
- Engineers who had contributed to the puppet were often not able to attend events and see the outputs of their efforts.
- Some collaborators felt their skills had been underused, whereas others substantially exceeded their allocated time commitment.
- The resources as defined in the bid were generally insufficient to deliver such an ambitious project.
- Researchers who contributed to the film documentary were not able to share directly in the experiences of those who saw the puppet.

4.2.2 Audience Engagement

- The stickers that were handed to audience members were not long-lasting and were thought by some members of the team to be not very attractive.
- The fact some audience members believed that the puppet looked like it was wearing bandages may could have distorted their responses e.g. could have made them overly sympathetic towards the puppet.
- Combining the intended introductory video and film documentary was a not wholly successful compromise. The final output received mixed feedback.
- The quality of the engagement was very dependent on the puppeteer and would be difficult for other researchers to replicate.

4.2.3 Impacts

- There was no pre-prepared media package, meaning that opportunities to influence media coverage directly were missed. In addition, handling media requests became very time-consuming for the project manager and Principal Investigator.
- It was difficult to capture the whole story and a complete view of impacts on film.
- The complexities and subtleties of the subject combined with the short duration of engagements at festivals leant themselves to a deficit approach to engagement as opposed to dialogue as understood by science communication practitioners.
- Widespread media coverage may have influenced publics' preconceptions of the puppet.
- There is some evidence that individuals just got on with their own tasks, with members of the creative and engineering communities not sharing directly with one another what they were doing. Individuals' understanding of the project as a whole could have been enhanced by more direct or better networked sharing of information.

4.3 Film feedback

Contributors to the film and other researchers were asked for their opinions about the film. There was general agreement that it was a high quality production, which was both very beautiful to look at and sounded very good. However there were some issues. Generally, it was felt that the pace changed about 60% into the film and that the earlier part was more successful than what followed, which was deemed overly repetitive. The change from a factual documentary to an artistic interpretation surprised some who were not sure why this shift had occurred. It also prompted questions about the clarity of the film maker's brief.

Whilst some contributors were happy with the way they were represented, others were concerned about a perceived bias in the editing which emphasised the negative aspects of social and emotional robots. They felt that it did not accurately reflect their interviews and also differed significantly from the balanced factual documentary that they agreed to be part of. They felt they should have an opportunity to review their contributions as part of the editing process.

A commonly expressed view was the fact that the film would have benefited from some commentary on the deeper level understanding of the impact of the puppet and robots in general. It was suggested that a psychologist could have provided valuable professional insight and interpretation about what was happening.

4.4 Opportunities

It was agreed that a number of opportunities had come to light during the project.

- To move towards a more dialogue-centred model of public engagement by taking part in activities which were conducive to longer interaction times and which would have allowed for clearer links to be made between the puppet and current research.
- To hold a second project meeting at the end of the pilot phase. This would have increase sharing and improved communication between members of the project team, in particular the creative and engineering communities. It could also have formally reviewed the allocation of resources leading to more effective use of individuals' time moving forward.
- To include a behavioural psychologist in the team and record their views on film. This professional input could have explained some of the audience reactions and responses and complemented the input from the robotics researchers.
- To create an information pack for schools in order to address the requests received from teachers, without having to visit large numbers of schools.
- To create a media pack in advance, incorporating pre-approved film footage and images, thereby helping to ensure that reporting was as accurate as possible and minimising the time demands caused by media enquiries.
- To exploit commercial interest from the toy industry. It was felt this could raise the profile of robotics research and provide future sources of funding, but it was agreed that the process must be handled carefully.

4.5 Lessons Learnt

The project team were able to describe a number of lessons that could have benefitted Heart Robot and which would be of benefit to future engagement projects.

1. Volunteers can be used successfully to deliver public engagement projects. Their time, energy and goodwill can be invaluable. It should be borne in mind that their input requires the same planning as paid-for resources and their availability and its timing is not always easy to control.
2. Managing and sharing expectations of collaborators requires the clearest possible communication. This project would have benefitted from clearer and more consistent shared understanding of roles, objectives and boundaries, which could have helped to optimise resource allocation and utilisation and minimised any problems that may have arisen from confusion.
3. Combining the management, administration, design and performance roles for one single individual within a project with a very short development timescale is unsatisfactory. Future projects would benefit from longer development times, or if this is not possible, separation of the design and management roles to ensure tight development timescales are met without compromising outputs.
4. Ambitious, innovative projects require the greatest possible levels of flexibility when it comes to allocation and utilisation of resources. Lack of flexibility results in insufficient resources being available to take advantage of all the opportunities which may arise during the lifetime of a project.
5. Simplifying the functionality of the engagement offering (in this case the puppet) may increase its audience appeal and need not necessarily weaken the impact of a project.

5 Conclusions

These conclusions begin with an overall appraisal followed by specific points about each of the project's five aims then move on to the other evaluation questions listed in section 2.1.

The innovation and achievements of all the individuals that participated in Heart Robot should be celebrated and shared and the project should be regarded as a success. It was extremely ambitious and used a novel approach to communicate some extremely complex ideas. It also managed to attract renowned roboticists, who appear on the website and internationally-recognised performance and animatronics experts who collaborated on the design of the puppet and the performance. In the skilled hands of the puppeteer, Heart Robot captured the imaginations of public audiences and the media. It acted as a catalyst for thought and discussion amongst the public and introduced them to questions that researchers are still exploring. Its humanoid appearance and the fact it was hand crafted was thought to have added greatly to the puppet's appeal and ability to draw in people who may not normally participate in science and technology. Volunteers and collaborators in the project described their involvement as highly rewarding, with many of them saying they learnt much about themselves and that they felt privileged to have been part of something they think was very special.

Despite the project's success a number of challenges were encountered. The nature of the interactions and the characteristics of the events limited the opportunities for members of the public to learn much about current research or engage in a true dialogue with researchers. There was also some confusion about the project's objectives and boundaries as demonstrated by the film, which was initially intended to be a factual documentary and ended up being an artistic interpretation of the project. This disappointed some researchers, including some contributors to the film.

The performance of Heart Robot was extremely successful in attracting and engaging members of the public. Generally it was very well received and provided a **hands-on interactive encounter** that stimulated introductory-level discussions amongst members of the public and between researchers and publics about the broad subject area of emotional and social robots. It should be acknowledged that the quality of the engagement was very dependent on the puppeteer and his skill resulted in a wide range of behaviours exhibited by the puppet. This coupled with short interaction times meant that the novelty did not wear off quickly and as a consequence each Heart Robot performance was able to engage all age groups and genders.

Of the 14 events attended by the project, only four were normally associated with science and technology. Successful audience engagement was achieved at science and **non-science events**, including those where many louder, more-obvious attractions were also present. Audiences at the non-science events predominantly consisted of families.

The number of unique visitors to the website indicates that those who saw the puppet or heard about it in the media were **able to follow up their interest**. 77% of respondents to the on-line survey indicated that they were very or quite likely to return to the site for further updates and information. Comments from survey respondents and those who saw the documentary film, demonstrate that the website and the film have encouraged people to think about the subject in some detail. The number of postcards handed out show that these were popular, although it is difficult to assess their direct impact.

The project team and volunteers consisted of members of the creative and engineering communities. The input of individuals from both groups has been crucial to the project's success. They were able to share their experiences at the project initiation and discussion

events. Whilst there is some evidence of **collaboration between the two communities** and recognition of one another's skills, there was limited scope for true shared understanding between members of both groups. Many of the key relationships, e.g. between the puppeteer and performance advisers, were already in existence. Added to this the project manager had good knowledge of both communities, which meant that he, rather than a shared communication network, became the conduit for any information exchange between the creative and engineering teams.

Members of the project team were delighted and surprised by the public's responses to the puppet, indicating that they have become **more appreciative of public engagement**. It was unfortunate that time constraints and work pressures resulted in very few researchers seeing the puppet in the field, meaning they did not observe first hand the public's responses to their work. However their comments indicate that they have gained some knowledge about an alternative form of public engagement, i.e. something that is not a public lecture or booth at a science festival. It would have been advantageous for the researchers who took part in the documentary film to have seen the interaction at first hand. This would have enabled them to comment directly about Heart Robot.

The evaluations show that the performance had positive **impacts** on most audiences. Those at the events found their encounter with the puppet to be enjoyable. Nearly all over 12s who were interviewed rated Heart Robot as 'very' interesting or 'very' thought provoking. Furthermore, over 90% rated it as 'very' or 'quite' interactive and fun. Similarly 81% of interview subjects aged 12 or under gave Heart Robot its highest-possible rating. It is also shown to have had an impact on audiences' attitudes to robots. 77% of over 12s indicated that they would continue to discuss robotics after events compared with 42% who indicated that they had a prior interest. Further evidence of this impact is provided in the numbers of interviewees who said that Heart Robot had changed their feelings about robots (83 % of over 12s and 81% of those aged 12 or under). In all these cases the subjects' comments indicate that it had made them feel more positive about robots.

The lengthy and erudite thoughts and opinions expressed by interview subjects, on postcard responses and by visitors to the website demonstrate success in **communicating the project messages** and thus promoting consideration of social and emotional robots. However some of the responses show misinterpretation of the research indicating that the messages were not always clearly understood. Reasons for this include some confusion about the specific nature of those messages, the short interaction times that were characteristic of the events and the extensive media coverage which may have distracted from the messages or resulted in unrealistic notions of what Heart Robot represented. There is a suggestion that some audience members were confused about whether Heart was a robot or a puppet. This confusion could have been reduced if it was less reliant on the puppeteer or less humanoid in appearance.

The project identified a number of **opportunities and lessons** that could be of use to future similar activities. The response from audiences at events and on-line indicate that there is an appetite for further engagement of this type and about the subject of emotional and social robots. A challenge for the project team is to create a new engagement hook that builds on the successes of Heart Robot without replication, while moving forward and extending the dialogue about a very important research area.

6 Recommendations

Recommendation 1: The BRL should continue to participate in engagement activities related to social and emotional robots. Heart Robot has provided the learning and experiences for the next project to have maximum impact. It is crucial that any future project does not replicate Heart, but seeks to progress and broaden the debate by incorporating a strong hook and adding opportunities for longer interaction times and creating possibilities for extended dialogue between researchers and publics.

Recommendation 2: Innovation in the form of creative input to ‘science communication’ projects should be encouraged. Heart Robot is evidence that tapping into the expertise of other communities can lead to some exciting and highly engaging projects as well highly rewarding experiences for the participants. It also demonstrates that internationally-renowned performance experts can be attracted to collaborate in science projects.

Recommendation 3: Expectations members of the project team including collaborators and volunteers should be carefully managed. There were instances of misunderstanding about objectives as well as roles and responsibilities. This may have been partly due to the many roles assigned to the project manager. In addition to a more equal division of roles, some other simple mechanisms could help address this issue and aid any project manager. Such mechanisms could include a statement of agreed objectives and roles being produced and written jointly by the project team, or scheduled review sessions involving wide representation of the team.

Recommendation 4: A longer lead time should be incorporated in future projects to optimise development and facilitate more comprehensive planning. For Heart Robot, crucial parts of the project such as a fully functioning puppet and the website were not in place at the scheduled start. This was largely due to the lead time being outside the team’s control. A longer lead time would allow issues like uncertainty about objectives to be addressed as well as enabling items like media packs to be developed, meaning team members could focus on their main tasks in the delivery period.

Recommendation 5: Consideration should be given to creating funding mechanisms specifically for the design and development of public engagement materials. The funding for Heart Robot was focused on delivery. However a considerable amount of the human and other resources were required for development and design. Having separate funding streams would ensure adequate resources are available for both design and delivery.

Recommendation 6: Opportunities for sharing ideas and experience within all members of the project team and between collaborators should be promoted. The levels of individual creativity were impressive. However, it was frustrating to hear that not all members of the project team had observed the impacts of their work or fully experienced the contributions of their collaborators. The innovation and achievements of all the individuals who participate in ambitious projects should be celebrated and shared at intervals throughout the life of that project.

Recommendation 7: Reallocation of resources should be possible. Innovative projects require maximum flexibility when it comes to resource allocation. Some individuals in the Heart Robot team felt they were underused whereas others were giving up much of their spare time. The funding structure for future projects should be sufficiently flexible to ensure resources can be reallocated to optimise their use.

Appendix 1

Audience Interview Questions

Questions for those aged over 12

1. What are the three words that best describe HEART to you.
2. How would you rate HEART based on the descriptions below?

	Very	Quite	A little	Not at all
Interesting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Interactive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fun	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Thought provoking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. WHY do you think this:

4. Please indicate the number that represents your view :

Do you think you will discuss robots after today?

I definitely won't 1 2 3 4 5 I definitely will

How interested in robots were you before today?

I was not at all interested 1 2 3 4 5 I was really interested

Do you believe that robots can have emotions or feelings?

Definitely no 1 2 3 4 5 Definitely yes

5. Has HEART changed how you feel about robots? In what way?

6. What is your age:

Under 16 (please state) 16-25 26-35
 36-45 46-55 56-65 66+

7. Gender:

Male Female

8. What are your thoughts and questions about HEART?

Questions for 12 or under

1. What did you think of HEART?

Good

Average

Bad

2. Please tell us why you thought this about HEART:

3. Has seeing HEART changed how you feel about robots? If so, in what way?

More interested

No change

Less interested

5. Why HEART has changed your thoughts about robots:

6. Gender:

Boy

Girl

7. Age:

8. Any other comments or questions:

Appendix 2

On-line Survey Questions

How did you **hear about this site?**

Saw the puppet
(please state where)
.....

Search engine (please
state)
.....

Friend or colleague
told me

Saw postcard

Don't know / can't
remember

Other (please state)

Your **age?**

Under 12

12-17

18-25

26-25

36-45

46-55

56-65

66+

Your **gender?**

Male

Female

Your **home town, city etc.**

How **interested in robots are you?**

Very interested

Quite interested

Quite uninterested

Not at all interested

Definitely yes

Yes

May be

No

Definitely no

Could you ever **love a robot?**

Could **a robot ever love you back?**

How could **robots with emotions
or feelings affect us in the future?**

.....
.....

How **likely are you to return
to this website?**

Very likely

Quite likely

Quite unlikely

Not at all likely

Is there **anything else you'd
like to say about Heart
Robot or this website?**

.....
.....