

Journey to the Centre of the Brain

**An evaluation of the *MakeBelieve Arts* live
show & on-line films about the brain**



Ben Gammon Consulting

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Executive summary

The live show

- Pupils from Years 2 to 6 found the live performance of *Journey to the Centre of the Brain* exciting, enthralling, personally relevant, informative and thought-provoking
- The use of music, songs, humour, characterisation, props and physical theatre was appealing for both pupils and teachers, and succeeded in making brain science accessible to audiences as young as 6 or 7 years of age
- Pupils demonstrated sustained learning from the live show in particular: that the human brain has evolved over time, that it consists of different parts with different functions, and that the different parts of the brain need to communicate with one another
- The live show also increased pupils' interest in brain science and generated discussions that extended well beyond the end of the show
- Teachers valued the way in which the show developed pupils' learning skills and emotional awareness as well as for increasing their knowledge and understanding of science
- Teachers also commented on how the show had increased their own understanding of how children behave and learn
- Some of the teachers set follow-up work for their pupils after the show including designing posters, writing reviews, running class-room discussions and watching the on-line films
- The MakeBelieve Arts team encountered a variety of practical challenges performing the shows in schools – e.g. coping with noise, people walking through the performance area, clashes with the school timetable – however they were able to successfully negotiate all of these difficulties
- Two other problems proved to be more intractable: i) persuading teachers to watch and take part in the live performance; ii) conveying information about the on-line films to the relevant members of school staff

The accompanying films

- The accompanying films succeeded in reproducing many of the positive aspects of the live show. Pupils and teachers enjoyed the use of music, songs, humour, characterisation, props and physical theatre
- Like the live show, the films were shown to have increased pupils' and teachers' understanding of and interest in the human brain
- Films that had a strong narrative structure, which illustrated how different parts of the brain worked together and/or which explored issues that pupils could directly relate to were particularly successful
- Convincing teachers who had not previously seen the live show to use the films is more challenging. Specific issues that need to be addressed were identified as:
 - Making teachers aware of the existence of the films
 - Ensuring they can access them through the schools' firewall
 - Ensuring that distracting adverts and links to other films do not appear on screen
 - Quickly and concisely communicating the content and educational potential of the films (including cross-curricula relevance e.g. PSHE, English, drama as well as science)
 - Reassuring teachers that the content will be accessible for key stage 2 pupils
 - Reassuring teachers that their pupils will find the films appealing
- Live action films is an appealing medium for teachers if the films:
 - Use techniques such as songs, acronyms and repetition of key words and ideas to reinforce learning
 - Include visual illustrations of complex processes
 - Show new / difficult vocabulary on screen
 - Feature actors from diverse backgrounds
 - Are of appropriate duration i.e. 5-10 minutes
- A model of a successful live-action educational film is shown on the following page
- In addition to the benefits gained by teachers and pupils, the MakeBelieve Arts team also gained increased knowledge of and interest in brain science, the confidence to use live performance and film to engage children in other areas of biomedical science and specific skills in film production



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1. Background to the project

MakeBelieve Arts were awarded funding by the Wellcome Trust to tour the theatre in education show *Journey to the Centre of the Brain (Journey)* and to develop a series of accompanying online films about the brain.

Journey is aimed at children aged 7-11 years old and tells the story of a 9 year old boy who, anxious about a school test the next day, falls into his own brain. He meets his neo-cortex who takes him on a journey where he encounters his amygdala, temporal lobe and hippocampus, and learns how information is stored, processed and retrieved.

The learning objectives of *Journey* and the accompanying films were to:

- Use story, characterisation, narrative, visual, aural and kinaesthetic techniques to engage 7-11 year olds with biomedical science topics not normally taught to this age group (brain science)
- Develop their understanding of what happens in their brains
- Encourage them to be curious, to ask how and why things work in the way they do
- Encourage their scientific and creative thinking skills
- Stimulate their interest in biomedical science

And to inspire their teachers to:

- Deepen their knowledge and understanding of human biology and make use of it in their teaching
- Employ innovative techniques in their classroom

The on-line films were developed as an accompanying resource for the live show and as a stand-alone learning resource that reaches a wider audience.

Nine films were produced:

<i>Millions of Years Ago</i>	<i>Temporal Lobe</i>	<i>The Last Chocolate</i>
<i>Neo-cortex</i>	<i>Hippocampus</i>	<i>Old MacDonald's Brain</i>
<i>Amygdala</i>	<i>Neurons</i>	<i>A Day Out in a Balloon</i>

Millions of Years Ago describes how the human brain has evolved over millions of years; *Neo-cortex*, *Amygdala*, *Temporal Lobe* and *Hippocampus* describe the functions of different parts of the brain; *Neurons* explores how neural connections develop and are strengthened during the process of learning; *The Last Chocolate*, *Old MacDonald's Brain* and *A Day Out in a Balloon* explore how the different parts of the brain work together to control our emotions, thinking and behaviour.

The films can be accessed via YouTube or Vimeo at <http://worldinsideme.co.uk/>

Members of the MakeBelieve Arts cast provided pupils attending each show with a branded bookmark with the web address for the accompanying films. They also provided teachers with a one page leaflet about the films, describing their content and how to access them.

2. Methodology

This evaluation aimed to assess the impact of the live show, the on-line films and the combination of show and films, upon Key Stage 2 pupils and their teachers. Specifically it sought to assess:

- Pupils' and teachers' reactions to the live show and the films
- What pupils learnt from the show, the films and the combination of the show and films
- How teachers who have not seen the live show respond to the films as a stand-alone educational resources
- The lessons learnt by the project team about the use of live theatre and film as science education resources

The live show was evaluated using:

- Two focus groups with pupils from Years 3-6
- Observation of performances in three primary schools
- Analysis of the stage manager's reports from the 36 performances
- On-line survey of teachers from the 20 host schools
- Analysis of written comments from teachers who had watched the show
- An end of project debrief workshop with the MakeBelieve Arts team

The online films were evaluated using:

- Three focus groups with pupils from Years 3-5
- A focus group with 8 primary school teachers who had not seen the live show
- An end of project debrief workshop with the MakeBelieve Arts team

Online teachers' survey

Teachers at the 20 schools where *Journey* was performed were sent a link to an online questionnaire, hosted on the Survey Monkey website. In total 14 teachers (each from a different school) completed the survey.

Teachers' focus group

A focus group was held with eight primary school teachers from eight schools across the Greater London area. None of these teachers had seen *Journey to the Centre of the Brain* or booked other theatre in education events for their pupils. Prior to the focus group participants were provided with a link to the website hosting the nine films and asked to watch them ahead of the discussion. During the focus group the teachers were shown the films:

- *Millions of years ago*
- *Neurons*
- *Neo-cortex*
- *Temporal lobe*
- *A Day Out in a Balloon*
- *Old MacDonald's Brain*
- *Amygdala* (a short snippet from the beginning of the film)

Discussions were audio recorded for later analysis.

Pupil focus groups - films

A focus group was held at St. Bartholomew's C.E. Primary School, Lewisham with five pupils from Year 5. None of the pupils had previously seen *Journey* or the accompanying online films.

Two focus groups were held at Emerson Valley Primary School, Milton Keynes – one with six pupils from Year 5, the other with six pupils from Years 3 and 4. These pupils had seen a live performance of the show two weeks previously.

During these focus groups pupils were shown the films

- *Millions of years ago*
- *Temporal lobe*
- *A day out in a balloon*
- *Old MacDonald*
- *The last chocolate*
- *Amygdala* (a short snippet from the beginning of the film)

Discussions were audio recorded for later analysis.

Pupils focus group - the live show

Two focus groups were held at Chisenhale Primary School, Bow – one with six pupils from Years 3 and 4 and the other with six pupils from Years 5 and 6. All of them had seen *Journey to the Centre of the Brain* two weeks prior to the focus group. Printed photographs showing scenes from the show were used during the focus group to remind pupils of what they had seen.

As with the other focus groups discussions were audio recorded for later analysis.

3. Findings

3.1 Pupils & the live show

3.1.1 Pupils' reactions to the show

From the evaluator's observations at three schools, the feedback from teachers and pupils, and the show reports provided by the stage manager, it is clear that children from age 6 to 11 found the show to be exciting, enjoyable, thought-provoking and informative. Pupils enthusiastically engaged in the audience participation elements and were attentive throughout, even when the show was being performed in less than ideal settings with multiple distractions and poor acoustics.

In two focus groups pupils from Years 3 to 6 described the show as:

Active	Amazing	Awesome	Enjoyable
Exciting	Fun	Funny	Helpful
Hilarious	Humorous	Interesting	Involving

None of them suggested critical words or phrases to describe their experience. The only suggestions for improving the show were about including more audience participation and better quality props and lighting.

All of the pupils in the focus groups agreed that the show had increased their understanding of and interest in their brains.

"Before I went to the show I wasn't really interested in what happens in my brain" Year 3-4

"It made a big difference to how I think about the brain" Year 3-4

"I didn't realise how important my brain was" Year 5-6

In particular pupils liked the jokes, songs and gymnastics performed by the actors and the audience participation elements. They found the experience to be far more engaging than their usual science lessons.

"In class it's quite boring because you're just sitting there and looking ... in the show you get involved in it" Year 5-6 pupil

"It's giving you information while having fun" Year 5-6

"In class we're just sitting there and looking at a whiteboard" Year 5-6

"It's a lot better than someone just telling you about it because you get to see it in a fun way" Year 3-4

Several of the pupils mentioned relating to the character Zac. Like him they do their homework at the last minute, find lessons boring and tests stressful.

"A lot more relatable because a lot of us don't want to do our homework" Year 5-6

"I always do my homework on Thursday night when it's due on Friday" Year 3-4

"I forget about [my homework] being in my bag" Year 3-4

A short Q&A session was held at the end of all but 3 of the 36 performances. Pupils asked a wide range of questions about the science content, the accompanying films, the narrative and characters, the actors and how the play had been developed.

Just under a third of the questions recorded in the stage manager's reports related to the brain.

- Why is our brain the shape it is?
- Is your brain attached to your skull?
- Are those parts really in our brain?
- Why do you call different parts of the brain different names?
- What's the part that controls your emotions called?
- Do you need the amygdala part of your brain?
- Does your brain actually talk to you?
- Would the cells inside the brain have their own brains? Like a brain inside a brain?
- How does the brain know what to do at different times, like what the different cells need to do?
- Are there any other things that the neurons can do?
- Does the cerebellum control the tongue?
- Do brain freezes affect your brain?
- What happens if you damage your cerebellum?
- Can you get paralysed if you damage your cerebellum?
- When your brain is damaged, can you fix it again?
- Are there more [neural] templates?
- Do you have a neo cortex that can move your whole body?
- Why do [the parts of the brain] all have to connect?
- Why is the brain a really important part?
- Does [what happened in the play] when I am sleeping?
- What happens when you're dreaming?
- Sometimes you might get a dream and sometimes you don't, why?
- When you sleep walk, why is that?
- What's the most important part of our body?

The other questions from pupils related to the actors and the play including: how and why the play had been developed; how long it had taken the actors to learn their parts; in how many schools it had been performed; how the acrobatics and stage tricks were done; what props and scenery represented; which part of the play the actors most enjoyed; and how the supporting films could be accessed. The most frequently asked question was 'how well did Zac do in his test?' [NB the narrative ended before Zac took the test].

The number and range of the questions elicited strongly suggests that the pupils' attention and interest was captured by the show, that they were able to follow the narrative and found the science content thought-provoking.

3.1.2 Evidence of pupils learning from the show

Two weeks after seeing *Journey* pupils from Years 3 to 6 were able to remember the main characters, large sections of the narrative, some of the songs and many of the key learning points from the show including:

- The names of different parts of the brain - the amygdala, neo-cortex, neurons, synapses, templates and the cerebellum were all mentioned without prompting from the evaluator
- The functions of different parts of the brain
- That the brain has a three part structure – reptilian, emotional, thinking
- That characteristics associated with an object are grouped together into structures called 'templates'
- That brain cells form new connections when you learn new information
- The conditions that enhance learning and recall – active participation, emotional involvement
- That the human brain is uniquely complex

“The amygdala tells you how to respond to things but normally it’s not actually a very good response” Year 3-4

“Neo-cortex the thinking brain” Year 3-4

“Neurons they form a synapse when you learn new information” Year 3-4

“Your brain is not just a squashy ball stuck in your head” Year 5-6

“If you’re excited about something you do well at something” Year 3-4

“My brain isn’t like a search engine” Year 5-6

“We’re one of the most advanced species on the planet” Year 5-6

The illustration of neural templates (which involved audience participation up on stage) seemed to have been particularly memorable and was frequently mentioned in some detail during both of the focus groups.

“When I think of an object like this chair there’s going to be like a diagram in my brain showing all the qualities of a chair” Year 5-6 pupil

“When you think of something all those templates light-up” Year 5-6 pupil

The show had also provoked further discussion in class, the playground and at home with parents and siblings. Nearly all of the pupils mentioned discussing the show with someone.

“My sister [also] saw the show and we tried to act it out afterwards” Year 3-4 pupil

“When I got home I went to play with my Lego and I acted out the play with my Lego” Year 3-4 pupil

[Having taught her mother one of the songs] “She actually learnt something about her brain” Year 3-4 pupil

“I talked about it at break” [with her friends] Year 5-6 pupil

Pupils described with pride being able to teach their parents something about the brain.

“My mum, she didn’t know about the neo-cortex” Year 5-6 pupils

The focus groups themselves were a catalyst for further discussions with pupils avidly discussing questions such as to whether they really had little people inside their heads and if so what was inside those people’s heads; and the differences between the human brain and advanced computers.

3.2 Teachers & the live show

3.2.1 Teachers' expectations for the show

Teachers responded to the on-line survey said they had hoped the show would enable their pupils to:

- have fun
- learn about their brains
- gain greater confidence in their ability to learn
- develop their learning skills
- deepen their understanding of their emotions

Learning how to learn, and developing social skills were particularly important outcomes for these teachers.

“Realise the strength that their brain holds” Primary school teacher

“Explain how the brain takes in information and how this relates to their learning” Primary school teacher

“How they can play a part in helping themselves to concentrate and make choices that are good for their learning” Primary school teacher

Although they acknowledged this to be complex science that falls outside of the Key Stage 2 science curriculum they nonetheless felt it was interesting and worthwhile for their pupils. Several of the teachers identified the links between the content of the show and the Personal, Social, Health and Economic (PSHE) curriculum they were teaching.

“The choices you have to make, perhaps on the playground, where it's like a survival thing and someone has upset your feelings and it's like ‘should I punch them, should I run away’ it's that thought process. The reptilian brain, the amygdala doesn't always give us that time to think about our actions” Primary School teacher

Schools that had booked the show were clearly ambitious in what they teach their pupils and believe in the value of going beyond what is in the curriculum.

“Part of our school ethos is that learning is the main focus. We've obviously got to teach the curriculum but to create lifelong learners they've got to understand how they work as an individual” Primary school teacher

“I think children are far more sophisticated than they were 10 years ago because of what information they can access now” Primary school head teacher

3.2.2 Teachers' reaction to the live show

The response of teachers to the live show – from the on-line survey, the depth interviews and the written comments collected by the stage manager – was overwhelmingly positive. Teachers felt that it was age appropriate and appealing for their pupils (even down to Year 2) and that it deepened their understanding of their brains, how they learn and the causes of their emotional responses.

"Acting was brilliant! Actors explained how the brain works in a child friendly way. Actors kept the children engaged and informed. Great show. I would recommend this production for other schools to experience" Primary school teacher

“I found it really engaging with enough humour and audience participation to keep all children engaged. Perfect subject matter as it was very relevant, especially for year 5 and 6. Subject wasn't too complex and all could keep up” Primary school teacher

“Very funny. Informative and expansive vocabulary and knowledge. Engaging. Very enthusiastic actors. Child friendly – got them involved. Children will be able to remember the basics of the brain – always a good thing! Songs and actions very engaging. Nice message about memories. ‘It’s important to see your strengths’” Primary school teacher

“The start caught the children’s attention. It’s good to focus on not doing homework! The children took it seriously – and also the letter. I loved Zac’s dance with the hoops – I don’t think the children have seen anything like that. Their concentration was fantastic. In the brain the repetition and analysis made it easy to understand. The templates were a clever model. Involving the children made the audience pay more attention” Primary school teacher

Of the 82 written comments collected from teachers who watched the show only seven contained any critical aspects and all of these comments also included compliments. All of the teachers who responded to the survey felt that *Journey to the Centre of the Brain* had met (6 teachers) or exceeded their expectations (8 teachers). All of them believed that the show was engaging for all of their pupils across the range of abilities. In particular they praised the use of humour, music, song and visual illustration to make complex ideas easy to understand and remember.

“Thank you for the show and being so inclusive with all of the children that attended. You made one boy’s day by choosing him to come and join in and ask questions” Primary school teacher

Of the 82 written comments collected after the shows, complimentary comments were made about:

- The way the show had held pupils attention (32 mentions)
- The use of active participation (29 mentions)
- The use of dance, music, song & physical theatre (21 mentions)
- The use of humour (17 mentions)
- The relevance to pupils’ school work (14 mentions)
- The relevance to pupils’ own experiences (14 mentions)
- The way in which it introduced & explained scientific vocabulary (12 mentions)
- The quality of the acting (10 mentions)

3.2.3 Teachers’ assessment of the show’s impact

In the on-line survey teachers were asked to assess the impact of the show upon their pupils against the projects learning objectives. Their responses are shown below in Table 1. All of these teachers felt that the show was very or quite effective in:

- Using characterisation and narrative to engage pupils with complex science topics
- Stimulating pupils interest in this area of science
- Using visual, auditory and kinaesthetic techniques to engage pupils with these topics
- Developing their understanding of what happens inside their bodies
- Encouraging pupils’ curiosity and to ask how and why things work the way they do
- Developing pupils’ creative thinking skills
- Supporting their learning about the process of scientific enquiry

Teachers rated the show most highly in terms of ‘use of characterisation and narrative to engage pupils with complex scientific topics’ and ‘stimulating their interest in brain science’.

Teachers were also asked to rate the impact of the show upon their own knowledge and interest in brain science. There responses are shown below in Table 2. All of the teachers felt that the show was very or quite effective in:

- Increasing their knowledge of human biology
- Inspiring them to develop innovative teaching techniques

12 of the 14 teachers felt that the show was also effective in increasing their interest in biomedical science although 2 thought it was fairly ineffective in this respect.

From the survey, interviews and written comments it is clear that teachers felt that the show was successful in delivering the desired learning outcomes, in particular:

- The names and functions of different parts of the brain and how it evolved
- How to improve their learning skills
- The importance of emotions
- Confidence and inspiration to learn more about science

“Many of our Key Stage 2 classes are currently taking part in topics to do with the human body. This complemented our learning perfectly and taught them about how important the brain is to bodily function” Primary school teacher

“Lots of scientific terminology about the brain and its components. They also took away some practical information about how to make good choices that will help them to learn effectively” Primary school teacher

“The pupils now realise that to recall information e.g. for a test they have to learn and retain it in the first place” Primary school teacher

“A real in depth understanding of how the brain works and affects us in everyday life. It captured the children's interest perfectly” Primary school teacher

There was also some evidence from teachers' comments of pupils applying what they learnt from the show in their subsequent science lessons.

“The day after the show they mentioned templates when we were doing a mind map of previously learnt information about forces” Primary school teacher

“[The pupils] talked about it and said ‘I'm enjoying this I must be storing this in my memory’ and they were talking about how the brain is like a muscle and you have to exercise it, that if you are not challenged you are not learning” Primary school teacher

Some of the teachers also mentioned the value of the show for themselves – developing their own understanding of how children learn and why they behave in the way that they do.

“Staff are now fully aware on how the brain works and how different ways of teaching and styles of teaching are important”

“Explains why my children were the way they were until they were two and a half”

Table 1: Teachers' assessment of the live show's impact upon pupils

	Very effective	Quite effective	Fairly ineffective	Very ineffective	Not sure / missing data
Use characterisation & narrative to engage pupils with complex science topics	11	3	0	0	0
Stimulate their interest in this area of science	11	2	0	0	1
Use visual, auditory & kinaesthetic techniques to engage pupils with these topics	9	5	0	0	0
Develop understanding of what happens inside their bodies	8	6	0	0	0
Encourage pupils' curiosity; to ask how & why things work the way they do	8	5	0	0	1
Develop pupils' creative thinking skills	7	6	0	0	1
Support their learning about the process of scientific enquiry	7	5	0	0	2

N = 14 teachers

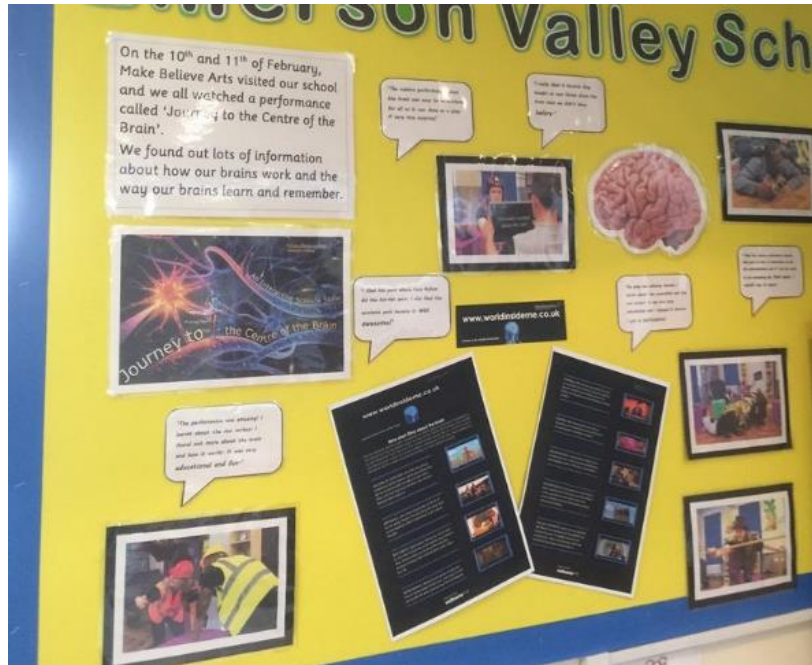
Table 2: Teachers' assessment of the live show's impact upon themselves

	Very effective	Quite effective	Fairly ineffective	Very ineffective	Not sure
Increasing your knowledge of human biology?	8	6	0	0	0
Inspiring you to develop innovative teaching techniques?	8	6	0	0	0
Increasing your interest in biomedical science?	5	7	2	0	0

N = 14 teachers

At least some of the schools had used the show and/or accompanying films as a learning resource over a longer period. For example:

- Emerson Valley Primary School - one of the Governors came to watch the show. Afterwards the pupils and teachers developed a small display about the show (see image below). The Head Teacher was also keen to provide a link on the school website to the accompanying films so that parents could watch them.



- Chisenhale Primary School - teachers took pictures of the show and following the live performance showed the accompanying films to their pupils and ran classroom discussions about the brain. They had also been used as a cross-curriculum resource for teaching English
- Prescott Primary School - the Deputy Head attended the second performance and took photographs of the show
- Holy Family Catholic Primary School - the deputy head wrote an article about the show for the school newsletter and included photographs of the show and a link to the on-line films so that parents could watch them with their children. One of the teachers also asked her pupils to write reviews of the show (see example below)



' Journey to the Centre of the Brain'
(An interactive Science Show)



What was the show about? Did you learn anything?

I was taught many interesting facts all about the brain by watching this performance. It was an extremely fun way to learn science. The actors took us to each part of the brain explaining all of it along the way. I learnt about all of the different parts of the brain and how they work.

I certainly learnt a lot from this show too!

What did you like the best and why?

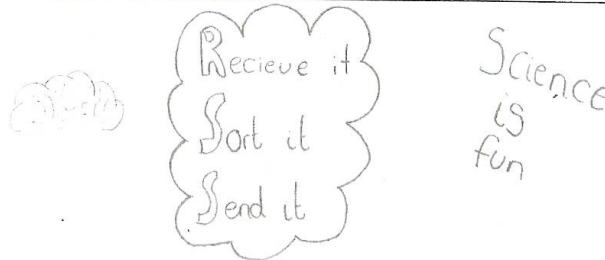
My favourite part of the performance was when the performers involved the audience such as the templates. They picked several members of the school to help them with the props. Although I was not one of the helpers, it looked really fun.

Would you recommend the show to others?

I would most definitely recommend this performance to others because it was enjoyable and other people could learn so much more.

What would you like to say to the performers?

Thank you so much for this incredible show and we all learnt so much more about the brain.



3.2.4 Teachers' suggestions for improving the show

Although the reaction of teachers to the show was overwhelmingly positive some of them raised concerns or suggested ways to improve the show.

- Need to display scientific words as well as saying them out loud (4 mentions)
- Complexity of language for age group (3 mentions)
- Complexity of some of the content – evolution of the brain, activity of the brain stem (2 mentions)
- Too much content in the middle section of the play for pupils to absorb (1 mention)
- More time needed for questions & answers at the end (1 mention)
- More emphasis on the message 'try your best' (1 mention)

Despite their very positive response to the show and its impact upon their pupils it was observed that many of the teachers only superficially engaged with the show themselves. In each of the three shows observed by the evaluator only one of the teachers remained for the entire show while 3 or 4 others left early or dropped in and out throughout the performance. Even among the teachers who stayed for the entire performance, most spent the time marking classwork and only occasionally stopping to

watch the show. The difficulty of engaging teachers' attention and persuading them to take part was raised during the project team's debriefing session as a cause of some frustration.

The MakeBelieve Arts team also reported difficulties conveying information about the accompanying films to the relevant teachers in some of the schools. Although this information was provided when the school booked a performance, the school administrator often did not pass it on to relevant teachers. Information was also provided by the actors at the beginning and/or end of each performance but as described above many of the teachers were not present when this occurred.

3.2.5 Practical challenges of staging the show in schools

Presenting live theatre in a school environment inevitably presented some practical challenges for the project team. Some schools were better equipped to host such events than others. During the tour various challenges were encountered although in all cases the team were able to overcome them or ameliorate their impact on the pupils.

- Clashes with the school timetable – having to work around school assemblies, lunch-breaks, end of the school day and other activities provided for pupils such as swimming lessons. Occasionally some of the pupils had to leave early or there was insufficient time for the Q&A session at the end of the performance. These problems were sometimes exacerbated by classes turning up late for the show
- Acoustics – having to cope with noise from adjacent classrooms, the school bell, having to perform in an echoing hall or in one case having to support a pupil who has a severe hearing impairment
- Performing in a thorough-fare – some of the venues were used by staff and pupils as a route to and from other parts of the school

3.3 Pupils & the films

All of the Years 3 to 6 pupils interviewed enjoyed the films and demonstrated evidence of having gained educational benefit from them – regardless of whether or not they had previously seen the live show.

Of the two schools where pupils had previously seen the live show, one had shown the films as a follow-up activity; the other had not done so by the time the focus groups were held. Nor had the pupils in this school watched the films at home although they had all received a bookmark with the web address printed on it and the teachers had received a 1 page leaflet about the films.

3.3.1 Science TV programmes that pupils watch at home

Pupils in the three focus groups struggled to spontaneously name any science TV programmes that they regularly watch in their free time. It would appear that such programmes are not their first choice of viewing although when encountered can be appealing. Most of the pupils had seen (and greatly enjoyed) the recent Pixar film *Inside Out* and most were avid viewers of *Horrible Histories*.

Of the science TV programmes that pupils had seen they liked those that explained science in clear and simple language and involved visually impressive demonstrations – e.g. models or explosions – and famous presenters such as Brian Cox.

3.3.2 Pupils' reactions to the films

Pupils' reactions to the films were overwhelmingly positive regardless of whether or not they had previously seen the live show. Having watched four or five of the films during the focus group pupils described them (without prompting) as:

Amazing	Educational	Enjoyable	Good
Fantastic	Funny	Informative	Interesting
Intriguing	Memorable		

None of them used negative words or phrases to describe their feelings about the films.

“Helps us learn but in a more fun way” Year 3 pupil

“I’ve never seen something like that before” Year 4 pupil

“It didn’t turn into a lesson” Year 4 pupil

“I loved it” Year 5 pupil

“Fun but you still learn” Year 5 pupil

“Makes you laugh and want to watch them” Year 5 pupil

The Last Chocolate, *A Day Out in a Balloon*, *Temporal Lobe* and *Amygdala* – were the most popular of the films (judging both by the comments of the pupils and their facial expressions and reactions while watching them). In particular pupils mentioned enjoying the humour, the music to illustrate different emotions, the use of actors to illustrate ideas and stories that they could relate to such as in *The Last Chocolate*.

“If there was one chocolate left, I would have to eat it” Year 4 pupil

“That’s what happens in my house” Year 5 pupil

“You know their situation” Year 5 pupil

“We’ve all done it” Year 5 pupil

Opinions about the animation *Millions of Years Ago* were more mixed. Some of the pupils liked the use of shapes to illustrate the characters and the storyline. Others felt that the animation was aimed at a much younger audience and lacked science content.

Pupils were enthusiastic about the idea of teachers showing these films in class and about watching them at home with their parents. They liked the idea of teaching their parents something about science and were sure that adults would find the films as enjoyable as they had.

“I can teach my parents about the brain” Year 4 pupil

Some of the pupils suggested that the entire performance of *Journey to the Centre of the Brain* should be turned into a film.

3.3.3 Evidence of pupils learning from the films

Both the pupils who had previously seen the live show, and those who had not, demonstrated increased knowledge about and interest in brain science. Pupils seem to have little difficulty understanding the key messages of each film although they struggled somewhat pronouncing words such as amygdala.

The pupils who had previously seen the live show recognised the actors and the characters that they had portrayed.

Pupils who had not previously seen the show had a rather vague understanding of the brain prior to watching the films.

“Information travels around your brain” Year 5 pupil; not seen show previously

“There’s one bit that’s conscious” Year 5 pupil; not seen show previously

“There’s a part of your brain you cannot control” Year 5 pupil; not seen show previously

“It helps you see and move your body” Year 5 pupil; not seen show previously

“You couldn’t live without it” Year 5 pupil; not seen show previously

Although these pupils mentioned the brain consisting of different parts they seemed unaware of their functions and names. Nor did these pupils mention emotions and their connection to thinking, planning and learning.

By contrast after watching five of the films these pupils were able to describe in some detail the different parts of the brain, the different roles they play, how they have to work together and the importance of instincts and emotions for survival.

“[the reptilian brain] shows you how to survive” Year 5 pupil; not seen show previously

“You need all your parts of the brain to function” Year 5 pupil; not seen show previously

“Your brain makes your emotions ... what you get in your brain is what you feel in your whole body” Year 5 pupil; not seen show previously

“You need to be worried in life, you might be too confident” Year 5 pupil; not seen show previously

“[the different parts of the brain] all work together as one. They have to chat” Year 5 pupil; not seen show previously

“It’s like a big conference; it’s like your brain has a conversation and at the end of the day there’s going to be a decision” Year 5 pupil; not seen show previously

“I knew there were different parts but I never knew what they were called and what they do” Year 5 pupil; not seen show previously

“I thought they all kind of did the same thing, it wasn’t whole different things” Year 5 pupil; not seen show previously

“If you had no memory you wouldn’t be able to talk” Year 5 pupil; not seen show previously

The pupils who had previously seen the show likewise mentioned a range of concepts that they had gained directly from the film, or from the show and then reinforced by the film. These included:

- The three layers of the brain – reptilian, emotional and neo-cortex
- How the brain evolved over time
- That different parts of the brain have different functions that are vital for survival
- That different parts of the brain have to work together
- Your brain controls your emotions
- The neo-cortex is involved in making plans
- The amygdala helps you to survive

“How the brain started to build up” Year 3 pupil; had seen live show

“[the brain] came in three different parts and they all evolved really slowly” Year 5 pupil; had seen live show

“How important each one of them is” Year 5 pupil; had seen live show

“[the amygdala] keeps you safe and stops you from getting hurt” Year 4 pupil; had seen live show

“I keep thinking after we watched the emotions one ‘I’m using that bit now’. That’s really interesting because I hadn’t thought of that before” Year 4 pupil; had seen live show

“It’s increased the way I think about my brain now” Year 5 pupil; had seen live show

The films were also the catalyst for discussions among the pupils – both those who had previously seen the show and those who had not done so. During the focus groups pupils spontaneously started discussions amongst themselves about:

- Which is the most important part of the brain?
- Who actually makes decisions – you or your brain?
- What would happen if you were born with part of your brain missing or you suffered a brain injury?
- What would happen if you had no memory? What wouldn’t you be able to do?
- If there really were little people inside your head, what would be inside theirs?

In summary the films were a popular learning resource that were successful in increasing pupils understanding of the brain regardless of whether or not they had previously seen the live show.

3.4 Teachers & the films

The films developed to accompany the live performance of *Journey to the Centre of the Brain* were tested with eight primary school teachers from eight schools across Greater London. None of these teacher had previously booked theatre in education events nor seen the live performance of *Journey to the Centre of the Brain*.

3.4.1 Teachers' use of on-line films in class

All of the teachers said that they already use on-line films in their teaching of maths, English and religious education. For them the characteristics of a good educational film – something that they would consider using in class - include:

- Duration of no more than 10 minutes
- Music and catchy songs to help children memorise key learning points
- Use of humour
- Bright colours and lots of visuals
- Key words shown on screen
- Relevant to children's current interests and tastes
- Good quality sound
- Use interesting questions and pauses to allow for whole class discussions
- Free access, no paywall, no pop-up adverts

They find these films primarily through Google or YouTube as well as the Times Educational Supplement and the websites [Discovery Education Espresso](#) and [The Literacy Shed](#).

“Children always like something on screen” Primary school teacher

“Better than just talking to them” Primary school teacher

“Quite good for helping children to remember different names of shapes” Primary school teacher

“You can teach children anything if you put it to a tune they vaguely recognise” Primary school teacher

However several teachers mentioned problems accessing YouTube films through their school's firewall. Which websites teachers can and cannot access varies depending on their local authority's policies - some can access YouTube while others cannot. Additionally if the film is rated above a G they need to get parental consent.

The name of a film can also sometimes cause access to be blocked.

“There's a particular game we used to use for phonics called 'poop-deck pirates' and as soon as you type that in!” Primary school teacher

Teachers also mentioned the problem of adverts or suggestions for other films appearing on screen and being either distracting or containing inappropriate material. As a result teachers have to spend time in advance blocking or skipping adverts.

3.4.2 Teachers' reactions to the *Journey* films

The teachers were somewhat ambivalent about the *Journey to the Centre of the Brain* films. On the one hand they were concerned that the films might not be appealing or accessible for their pupils. In particular they were concerned as to whether:

- The language would be too complex
- The concepts would be beyond their pupils
- Their pupils would like the films
- The science was accurate
- Families with strong religious beliefs would object to the content about evolution

On the other hand they were excited about the use of drama and song to illustrate scientific ideas, praised the use of live action rather than animation and were excited about the potential for cross-curricula teaching of PSHE, Literacy and Drama as well as science.

A couple of the teachers were concerned that the content was not relevant to the science curriculum.

“In seven years of teaching primary school key stage 2, and for four of those years being science coordinator, I’ve never ever really taught much about the brain in any detail” Primary school teacher

But most of the group were happy to teach this area of science and/or identified strong links to the PSHE curriculum they were teaching.

“This is the kind of stuff my management has actually been looking at in terms of teaching the children how our brain works ... how our thoughts happen” Primary school teacher

“We’ve been doing quite a big push on mindfulness” Primary school teacher

“Could be linked to behavioural management” Primary school teacher

The teachers seemed to be genuinely conflicted, claiming to be innovative and willing to try new resources while at the same time afraid of taking risks, unsure why these films had been produced and constantly seeking reassurance and affirmation from other teachers. Nonetheless by the end of the focus group the mood of the group was noticeably more positive with several of them expressing interest in using the films in their teaching.

3.4.1 What teachers liked about the films

As can be seen from Table 3 there was overlap between what some teachers liked and others disliked about the films. However all of the teachers praised the use of live actors rather than animation which they felt would help children better identify with the characters and would be a change from the animated cartoons they usually watch. The teachers also liked that there was a mix of ethnicity and gender among the cast.

The use of visual illustrations to explain complex ideas (e.g. the interaction of neurons and neurotransmitters), acronyms to summarise key points, the repetition of key learning points and song to reinforce learning were all mentioned as key strengths of the films.

Some of the teachers were keen to replicate aspects of the films in their own classes such as the painted image of the brain in *Neo-cortex*, the rap music in *Amygdala* and more generally the acting out of the stories to illustrate scientific concepts.

Day out in a Balloon was the most popular film. Teachers liked that it included all of the different sections of the brain, illustrated how they worked together, had a narrative that was easy to follow and was of an appropriate duration.

“Easy to understand that each and every part of the brain plays its own particular role”
Primary school teacher

“That was so interesting you could see what would happen if you didn’t have a particular part of the brain” Primary school teacher

“It was really clear what would happen if one part of your brain was damaged” Primary school teacher

“You can show the importance of emotions, even ‘bad’ emotions” Primary school teacher

Temporal Lobe was also popular with the teachers describing it as amusing, easy to understand and likely to appeal to their children. Some teachers liked the use of music to illustrate different emotions although a couple were concerned that cultural references such as *The Lion King* would be out of date. The rap music at the beginning of *Amygdala* was praised by teachers for creating a memorable character with ‘attitude’ who is likely to appeal to their Key Stage 2 pupils.

While some teachers were concerned that the *Old MacDonald* song would not appeal to their pupils, others liked the use of a familiar song to reinforce the learning of words through repetition.

Table 3: Summary of teachers’ likes & dislikes

Likes	Dislikes
Films with a clear narrative Use of acronyms to help recall Use of live actors & characterisation Use of humour and sound effects Visual illustrations of processes Music – catchy, familiar to children, memorable, helps with recall Cross-curricula relevance Props that are familiar to children / could be reproduced in class	Films that were too long / contained too much content Lack of a clear overview of each film Key words not shown on screen Not enough visuals Scenery & props not clearly linked to the brain Music – might not be age appropriate

3.4.2 What teachers did not like / were concerned about

The main problem teachers experienced was grasping the theme and purpose of each film and how they related to one another. Teachers often asked in which order they were supposed to watch the films and expressed the need for some sort of overview that briefly introduced all of the characters and where they were located within the brain.

In particular they were confused when a character appeared in a film whom they had not previously encountered. For example amygdala, temporal lobe and hippocampus all appear in the film *Neo Cortex*. If the teacher had not previously watched the other films about these characters they struggled to understand who they were and what their role was within the film. Although these characters are briefly introduced when they first appear in *Neo Cortex* this content was often overlooked. By contrast the narrative of *Day Out in a Balloon* and the song in *Old MacDonald’s Brain* were effective in introducing these characters.

The animation *Millions of Years Ago* although liked did not provide an effective introduction for the rest of the films. Teachers wanted to know from the very beginning of each film which part of the brain was being described, where it was located and how it related to the other parts of the brain.

Although all of the teachers liked the use of music in the films there was disagreement as to whether or not the songs chosen would be appealing to their pupils. There was also some concerns that the scenery and props were too abstract and not clearly related to the brain e.g. there were no images of real brains or brain scan images.

Some of the teachers felt that the content and language of the films would be too advanced for their pupils. However others strongly disagreed and were confident that their pupils would not experience any problems. Nonetheless all of teachers wanted more use of text in the films to emphasis key words – i.e. showing key words and phrases on screen as well as saying them out loud.

Neo Cortex was the least popular of the films. Teachers felt that it was too long, the pacing was too slow and it contained too much information and too many characters for them and their pupils to follow.

“Went over my head a little bit ... I didn’t know who was what” Primary school teacher

“There was a lot of information and a lot of acting out what was happening and it gets a bit confusing remembering who’s who” Primary school teacher

“I think the science gets a little bit lost in the dramatic background” Primary school teacher

One of the teachers questioned whether the content about the evolution of the brain was correct (although also admitting that he did not know much about biology). Interesting the association with the Wellcome Trust did not seem to influence teachers primarily because they did not know about the Trust or assumed it was a pharmaceutical company.

3.4.3 Teachers’ assessment of the likely impact of the films

All of the teachers in the focus group agreed that the films would deepen their pupil’s understanding of what goes on inside their brain - in particular that different parts of their brains have different roles and that it controls emotions as well as learning – and that they would encourage children to ask questions about how and why things work the way that they do.

They were divided as to whether the films would develop pupils’ scientific and creative skills and even whether this was a relevant outcome for the films.

In terms of the films’ impact upon them as teachers most seemed to be genuinely inspired by the approach used and inspired to copy some of the techniques they had seen.

“Shows you how simple it is to make props” Primary school teacher

“I haven’t ever really thought of using role play in science ... but seeing this it’s ‘oh that’s quite a good idea” Primary school teacher

“It’s given me more ideas for active learning than just watching me demonstrate” Primary school teacher

“I’m definitely going to use more drama when teaching scientific kinds of things” Primary school teacher

Several teachers described how the films had made them more confident and inspired to teach brain science to their pupils.

“This does make you feel more relaxed, a little more confident in your teaching about [brain science] and how to simplify it” Primary school teacher

“It does make you think about different parts of your body that you can teach that you wouldn’t necessarily think of doing” Primary school teacher

“I’ve realised you can actually teach this kind of thing about different parts of the brain and make it fun” Primary school teacher

“I feel I learnt a lot about the brain and also emotions and stuff. I think it’s been quite valuable for what I’ve learnt, let alone what I would teach the children” Primary school teacher

Table 4 below shows teachers’ written responses to the questions – what would encourage you to use these films with your pupils; what would you be concerned about; what are the best things about these films; how could they be improved and how would your pupils feel about them?

Table 4: Teachers' written comments about the on-line films

I would use these if ...	I would be concerned about ...	The best thing about these films is ...	These films would be better if ...	My pupils would think these were ...
<p>It was clearer in which order to watch them</p> <p>Key words were shown on screen</p> <p>More information was presented visually</p> <p>If I was teaching about emotions, mental health, mindfulness etc. in PSHE</p> <p>If the brain was covered in the science curriculum</p>	<p>The complexity of some of the vocabulary / concepts</p> <p>Whether lower ability pupils would be able to cope</p> <p>The films might not work in isolation</p> <p>Length of some films; pupils might lose concentration</p> <p>Content about evolution – parents with strong religious faith might object</p>	<p>They were fun, entertaining & humorous</p> <p>Contained real life situations pupils can relate to</p> <p>Provide opportunities for cross-curricula learning</p> <p>The music, sound effects, singing</p> <p>Use of drama & characterisation to explain scientific concepts</p> <p>The use of diagrams & acronyms</p> <p>The diversity of the actors – gender, ethnicity</p>	<p>There were more visuals</p> <p>Key words were frequently shown on screen</p> <p>Background information was provided for teachers</p> <p>Films could be shown in isolation</p> <p>There was a summary at the end of each film – key points & vocabulary</p> <p>Reference was made to where in the brain these things happen</p> <p>Characters were introduced at the beginning</p>	<p>Fun, humorous, exciting, inspiring</p> <p>Helpful with their learning</p> <p>An opportunity to learn about the brain</p> <p>A breather from standard science lessons</p>

3.5 The project team's reflections on the project

At the end of the tour the project team – actors, stage manager, creative director and those involved in the production of the films – came together for a debriefing session.

3.5.1 Impact of the project on the team

For the team the project had wide ranging and lasting benefits. As well as delivering powerful learning experiences for pupils and teachers the project had increased the team's understanding of the human brain and how people learn. It had made them reflect deeply on why they and other people feel, think and behave in the way that they do. The team were convinced that they would apply this knowledge to future theatre in education projects. Team members also felt that they had gained a greater understanding of the needs and wants of primary school teachers and how to better support their teaching of science.

For many of the team the project had been a challenging but ultimately very rewarding experience. They often described being 'taken out of their comfort zone' by having to work with a medium (film) and content (brain science) with which they had little or no prior experience. As a result they gained considerable skills, knowledge and inspiration – in particular skills of film production and script writing and a greater awareness of the potential of film as an educational medium.

Recruiting a knowledgeable and inspirational expert advisor was recognised as being of critical importance for this project. The project leader described how the expert advisor had worked with the team during the early development of the show and the films and had made them "fall in love with the brain". The expert advisor not only had a deep knowledge of the subject but also a good understanding of how to communicate with a lay audience.

The team were delighted by the positive response of pupils and teachers to the live show, and how it made the brain science accessible and appealing for audiences from adults down to 6 year old children.

3.5.2 Challenges encountered

Due to budgetary restrictions filming had to be done in the MakeBelieve Arts studios rather than a sound insulated recording studio. Aircraft and traffic noise caused constant interruptions which added significantly to the time required for the filming.

The team had also found that the science dictated the minimum amount of content that had to be delivered in each film, requiring some of them to be longer than was ideal. It quickly became obvious that each needed to tell a complete story in order to make sense.

The team expressed disappointment and some frustration at the difficulties of persuading teachers to watch and take part in the live performances along with their pupils. They also encountered difficulties making teachers aware of the on-line films. This problems was caused in part by teachers not attending the performance and by school administrative staff not passing on information provided when the initial booking was made. Although the leaflet and bookmarks were useful it was agreed that other additional channels of communication need to be used.

3.5.3 Lessons learnt

Reflecting on their experience of the project the team identified the following points of learning that they will apply to future science engagement projects.

- Finding the right scientific advisor is crucial – they need to be knowledgeable, passionate, a good communicator in their own right, generous in sharing their ideas and sympathetic to our approach
- The rehearsal room should be used as a space to play and experiment – role of the artistic director in guiding and facilitating this is vital. Involve the expert advisor in this creative process as early as possible
- Don't be trapped by the science curriculum – if it's interesting science you will be able to engage children and persuade schools to book the show
- You can engage children as young as 6 years old with brain science
- The film and live performance are powerful media to inspire and educate both children and teachers through the use of characterisation, narrative.
- Active participation during a live performance is crucial for this age range
- To trust film-makers as to what can be done with the medium – it's a creative journey
- The need to tackle firewall issues so that teachers can access films in school – e.g. providing films on both YouTube and Vimeo and ensuring that teachers know they can access the films via different platforms

3.5.4 Where next?

The team identified various ways in which the project could be developed in future, based on their own experience and on the findings from the evaluation. One of the major challenges would seem to be the number of potential routes that they could take this project and deciding which ones would deliver most benefit for pupils and teachers.

The on-line films

- Develop some sort of landing point / animated introduction that provides an overview of the characters and content of each film
- Include regularly updated content – images, videos, a blog, latest brain science research news
- A simple interactive game such as a quiz could be added to the end of each film to help re-inforce the key learning points
- Develop a more appealing 'take-away' that promotes the website e.g. a paper hat with regions of the brain marked on it

Marketing to schools

- Produce a promotional video of the show and on-line films for teachers
- Run preview shows for teachers in schools, teacher training centres, at the Association for Science Education Conference etc.

The live performance

- Run a larger scale tour across the UK and abroad linked to major science festivals
- Develop a version of the show aimed at teenagers
- Develop a theatre production of the show – with theatre quality sound, lighting, scenery, props
- Develop a promenade theatre version of the show
- Upgrade the quality of the existing touring props, lighting, sound
- Produce a film of the whole show
- Produce an accompanying book

4. Discussion

4.1 Theatre in education as a tool of science engagement

Journey to the Centre of the Brain illustrates the potential of story-telling, characterisation, song and visual illustration to engage pupils and their teachers in contemporary science well beyond what is covered in the science national curriculum. These approaches have been shown to be highly effective with children as young as 6 or 7 years of age.

The development of a story-line that was relevant and familiar to children seems to have been an important element of this project's success. Anxiety about tests, homework and performance in class is something that many pupils have experienced and can empathise with. Likewise dealing with difficult emotions in class, in the playground and at home are experiences familiar to Key Stage 2 children. For teachers the show and the films aligned with their desire to improve pupils' ability to learn and to develop their emotional maturity. Regardless of the relevance to the science curriculum many teachers valued the show and the films for their potential to deliver these learning outcomes.

Finding a science advisor who was an open-minded and skilful communicator in their own right, was crucial to the success of this project. This relationship enabled MakeBelieve Arts to experiment and innovate while having the confidence that the content would be scientifically accurate.

4.2 On-line films as a science learning resource

Many of the valuable aspects of the live show were successfully translated to the medium of film by the project team. Although the impact of film is unlikely to be as powerful as a live performance they nonetheless have shown their potential to engage Key Stage 2 pupils and their teachers with contemporary science content. These films seem to be especially powerful as a follow-up resource for the live show although they do also work as a stand-alone resource.

The major challenge for maximising the potential of the on-line films is tackling the innate (and perfectly understandably) conservatism of teachers. Research has shown that while some schools support and encourage teachers to try innovative approaches, others are indifferent or even hostile. The difference in response between teachers from schools that booked the live show and those who attended the focus group about the on-line films may in part reflect different attitudes to innovation in education. In a review of research into the challenges of applying innovative pedagogy in schools Kirkland and Such¹ identified the following issues:

- Teachers' perception of the distance between the innovative approach and their current practice
- Teachers' perception of the costs (time, money, technical resources) of implementing the new approach
- Teachers' perception of the usefulness of the innovation – will it help them do what they want to do
- How easily the innovation can be tried out, adopted and adapted to the needs of a particular school
- How easily can the benefits of the innovation be observed by teachers, the school's management team and parents
- Whether there is a supportive social environment for innovation – other teachers in the school and teachers' own informal network of contacts beyond the school
- Whether the schools' management team is supportive of innovation including accepting the risks involved e.g. waste of time and money, opposition from other teachers, parents or school governors

¹ Overcoming the barriers to educational innovation; a literature review: Kirkland K & Such D; published by NFER 2009 available at <https://www.nfer.ac.uk/publications/FUTL61/FUTL61.pdf>

- Whether the schools' management team is willing to delegate responsibility to staff and empower them to make decisions
- The extent to which the school is outward looking and connected to other schools and learning organisations

Kirkland and Such conclude that schools vary widely in their willingness to take up innovative approaches to teaching.

Late adopters of such innovation need reassurance and support in order to use the new resources. In particular they need convincing evidence that such resources will deliver significant benefits with minimal costs and risks. They need to quickly and easily understand what such resources have to offer and how best to apply them to the particular needs of their classrooms. Recommendations from other teachers and trusted sources such as the Times Educational Supplement are likely to be of significant help in addressing such concerns.

Persuading teachers to use the live performance and on-line films of *Journey to the Centre of the Brain* would clearly be of considerable value for both them and their pupils. This evaluation has shown them to be popular and engaging resources for primary school children and their teachers. Both together and as stand-alone resources they increase understanding of the brain's structure and function, and increase interest in biomedical science. Furthermore the techniques used in the films and live show provide teachers with ideas for innovative approaches that they can apply to a wide range of subjects from across the school curriculum.