It is a great pleasure to be here and thank you very much for making the effort, despite the transport system. Perhaps I need to do a special edition for those people that are walking home.

The benefits of singing in a choir relate, in part, to the benefits of singing itself, and just to give you some examples of some of the benefits that might accrue, some of the things we will be touching on this evening are: physical benefits – so, if you sing, and whether you are singing in a choir or whether you are singing on your own in the bath, whether you have had a gin and tonic or not, there is a respiratory aerobic activity, so even if you are sitting down, one of the benefits that you can have from singing, and if you do not feel like singing and actually standing, you are still actually giving the whole of your upper part of your body a workout. One of the great challenges of getting older is that your body’s ability to take up oxygen reduces, so your aerobic facility becomes more anaerobic, but you can reduce that particular challenge through exercise and one of the ways that you can exercise is by singing, and singing with other people also brings other benefits. As you can see, there are lists of physical benefits there. There are psychological benefits that you get from actually being with other people, and we will touch on those. Musical benefits, I will not spend too much time on this evening, but as you can imagine, if you are singing music, then you get to know something about music, which incidentally is of interest in itself. Educational benefits arise because you are actually engaged in a process of discovery - you know something more about the world and the world around you through the activity of singing - and then social benefits. So, the three things I will probably be focusing most on this evening are physical, psychological and social.

First of all, let us think about the human design, what I shall refer to later as the human body-mind. What happens inside the brain? Well, at the moment, as you are listening to me, I am just making a noise, and for some strange reason, most of you, perhaps the majority, are hearing this as some form of English and you are actually interpreting this in some way. What is going on inside your brain is being mirrored in that slide there, which is a cross-section through the brain of listening to someone talking.

So, on the left-hand side of the brain, you can see there are parts of the brain that are trying to make sense of the actual language itself being used, whereas, on the right-hand side, we have actually got the prosodic features of speech that are being picked up, things to do with melody, to do with intonation, the contour of your voice. That is how we can tell that someone is perhaps speaking English but they are not perhaps from Britain, from another part of the world. So, this is an automatic process, that the brain is designed to make sense of different aspects of the human voice, whether this is to do with the actual text or whether this is to do with the more musical prosodic features.

At the top there, you can see a slide by a German colleague, Boris Kleber, of overt singing.
So, what happens when we are singing? What you can see here is that, on the left-hand side of the brain, you have got aspects of the lyrics here being processed and the motor behaviour, which is being processed here. You have actually got part of the visual cortex, so that you have got imagery which is actually working as well. And on the right-hand side, you have got the musical aspects of whatever it is that you are singing, again linked to this kind of motor cortex, again, other visual association areas, and deep inside the brain, here, you have got the emotional centres linked up. Now, if you sit there at the moment and imagine yourself singing, which may or may not be to the benefit of the person next to you rather than actually singing, you can see that there are similar areas being lit up, but also, we have got a little bit more going on in the forebrain, if you like, known as the problem-solving activity. And here is the difference between imagining yourself singing and actually singing, so there is a network at the front of the brain which is actually involved in that. The reason that we might be interested in this is because people that sing are often singing to themselves – they have these tunes, melodies going round, what my colleague at Goldsmiths talks about, earworms, where you cannot get rid of the damn thing, you know, it is going round and round inside your head, and it is very like imagined singing.

Incidentally, the kind of pedagogical interest in this is that if you can encourage people to imagine themselves performing, it is a silent version of actually performing, and this is something that singers do anyway, whether you are doing the washing-up or sitting on the bus, should there be a bus, or a train, or sitting in the car. You are singing along anyway, and this is very similar to actually doing it out loud.

What happens when we hear someone singing is that we have an acoustic input, which comes in usually here and then gets distributed through the brain in a variety of different ways. You can see here, one part of the brain is converting those noises to something that you recognise as a language, so there is this acoustic to phonological conversion. At the same time, another part of the brain is intimately involved in rhythm and this links to motor behaviour. If you see young children, for example, listening to music, listening to singing, they never sit still. In our culture, they kind of have to move. In other cultures, movement is integral to music – you would not believe of trying to experience music without actually moving at the same time.

In terms of pitch, one part of the brain deals with the contour, if you like, the ups and downs of the melody. Another part then subsequently deals with musical intervals, and then tonality, and we know this from looking at adults that have some kind of brain damage, unfortunately, that if this part of the brain, this module, gets damaged, these two still function. If this one gets damaged, then these tend not to function. That is both in speech and in singing.

Then, at the same time, all of this experience is linked to our emotional world. So, as we hear the human voice, we automatically tag it with a particular emotional response, whether someone is speaking or singing, so that if
someone phones you up, you can instantly tell, despite the fact the telephone is dreadful at actually carrying sound – it filters out a lot of the signal – you can actually hear the emotional state of the person at the other end – “You sound very happy!” or “Something wrong? Are you okay?” So, we are cued into emotion with the human voice.

We recognise that another part of the brain has a form of musical filing cabinet, a musical library, and as you listen to music, you fit it into the library – is that new or is that the second drawer down, etc.

Then finally, we have associated memories that might link to that. So, if I ask you to think of your favourite singer at the moment, for example, or your favourite choir, you tend to think of them in terms of a time and a space and a location. You go to where you had that particular experience. We tend not to think of these kinds of experiences in the abstract.

Having heard someone sing, if someone said, “Could you just repeat that for me?” could you sing what you just heard? One part of the brain runs off the melodic musical features and another part runs off the lyrics. So, this is just demonstrating that the brain is modular, integrated modular, but within that modularity, there are sometimes challenges of the actual networking of the bits talking to each other, particularly if you are developing your singing skill.

This modularity, we see not just in singing but also we would see, here, this is a jazz improvisation, and you can see there is lots and lots of activity going on, not just in imagery at the back but lots of also forebrain thinking in real-time, creating music in real-time, but drawing on the experiences that you have got stored, as you pull them out in real-time to improvise.

We also see it in dance. This poor woman is being asked to rehearse tango steps whilst she is lying in a scanner, and you can see, here, there are different parts of the brain are involved, depending on whether she is just at rest or whether she is thinking and trying to move her feet in a particular way. So, we see this modularity in all of the art forms.

One of the challenges is that, as the technology has moved on, we have begun to realise that there are other things going on. This is nothing to do with music. This is a project which is just giving us some updated information on neuroimaging, and what you can see here are lines, are patterns of colour, and this is telling us that, as one part of the brain reacts, it sends messages off somewhere else, and these very clever neuroscientists are just beginning to capture this kind of imaging.

As far as singing is concerned, there is one particular part of the brain that we are interested in, which is this arcuate fasciculus, which you can see over here, from another slide, it runs around either side of the head and then links with the equivalent of a large hair-grip over the top, and this links the auditory areas with the motor areas of the brain, and these are implicated in the processing of language and vocal pitch and also singing in tune, whatever that means.
This study here is just demonstrating that if you took slices in various parts of this neurological feature, that singers tend to have parts of it much more developed than instrumentalists and the general public. So, the human voice particularly pays attention to this part of the brain.

In this example, these are two slides of this particular part of the brain from 60 year olds. The one on the left is a healthy musician and the one on the right is a healthy non-musician, and you can see that there is a difference there in the relative size of these areas, which is no surprise, is as you would expect. As you begin to use certain parts of the brain more, then those parts of the brain become enhanced, they become bigger. So we know, for example, that fiddle players have much more of their brain given over to the tips of the fingers of the left hand compared with the rest of us and compared with other musicians because those are the bits that they are constantly using, so these bits grow. We know, if you are a taxi driver, you have got more of your brain given over to spatial location and to mapping than most people who do not need to earn their living that way.

Usually, the language centres are more biased towards the left-hand side, and the other features of music, the prosodic features, to do with pitch and rhythm, are processed here on the right-hand side. But in this particular instance, this is an 11 year old girl. At the age of 11, she had a stroke. She was out playing with her friends, she had this massive stroke, which destroyed the language centres in the left-hand side of her brain, and then, over the next period of time, she was given melodic intonation therapy, so using melody and rhythm to actually encourage, very usually, the right-hand side of the brain, that arcuate fasciculus I mentioned, to develop, and here you can see, over time, through the imaging, how her brain has taken over the part that was actually lost.

This is another wonderful example of what you and I might call neuroplasticity. Neuroplasticity being that facility for all of us, irrespective of age, to learn new things. That is a feature of the brain. You do not get to a point and it suddenly says, “That is enough, fine, I have got enough information, thank you very much – do not need any more!” We can always learn new things. Some people do not always demonstrate that they are learning new things, but that is another issue.

Here is just some text about her. When she began therapy in 2008, she could not string words together, more than two or three words. Her speech was often ungrammatical, leaving her frustrated whenever she tried to communicate. Her treatment plan was intensive, an hour and a half a day, for up to five days a week, with 75 sessions in all. By the end of the 15-week treatment period, she could speak in sentences of five to eight words, sometimes more. Over the next several years, she treated herself at home, using the techniques she had learned during the sessions. Today, eight years after her stroke, she spends some of her time as a motivational speaker, giving hope and support to fellow stroke survivors. Of course, she is young so there is more opportunity for other parts of the brain to take over those parts that are lost, but this is a wonderful example of how certain features of music, in particular rhythm, which is implicated, for example, in reading, in phonological development. People that are dyslexic, for example, have real challenges in processing rhythm, and one of the ways we can help young children to become better readers is actually by doing lots of language activity which is very rhythmic.

In terms of the social processes of musical learning, what we see here, this is an example of children who are aged six, and then, over the 15 months, they were compared with a control group. These children were studying a keyboard instrument for half an hour a week, and what we see is evidence of brain changes in three areas, which link back to that arcuate fasciculus, of the auditory area, and the primary motor area, and the corpus callosum, which is a bundle of fibres which links the two hemispheres together. So, if you like, you have got these different modules, and they are all talking to each other through a bundle of fibres inside the head.

So, what has all that got to do with us? What are the impacts of singing lessons on brain function? Well, in this particular study is an adult who has just started singing lessons, and there is lots of forebrain activity – there is lots of thinking about doing the activity. At the end of a year of singing lessons, a shift in this activity to something which is far less conscious, lots of visual imagery going on, much more of a shift towards what we might regard as the more musical centres to do with melody and rhythm, and far less to do with language and thinking about the actual task.

In terms of singing development, well, this begins pre-birth. We have an image here of a foetus in the ninth month of foetal life, and at that moment, the first sound that all of us heard was our mother’s voice and the other sounds around us.
However mum was feeling, this was encoded in the way she was using her voice: if she was happy or sad or shouting at her partner or trying to get the infant to be calmed down and stop kicking inside the womb, for example. In this final trimester, the last three months of foetal life, the auditory cortex is functioning, so at the moment of birth, we actually enter a world already hearing, already having experience of hearing things, including mum speaking, mum singing, mum using her voice in particular. Through bone conduction, the sound from the mum’s voice is transformed through the body. At the same time, however the mother is feeling, because of the integrated body-mind, her emotional state is also encoded in the bloodstream. So, the foetus is getting two messages: it is getting an acoustic message and it is getting an emotional tagging of that sound. So, we enter the world already programmed for certain sounds to have certain emotional valence, certain sounds to be happy or sad or whatever, and one of the extraordinary things about the human voice is that major emotional states, such as being happy or sad, we all recognise, almost irrespective of the culture or the ethnic group or the language group. There is something about our innate humanity which is encoded in the way that we use our voice.

Let us just look at a little piece of video of this…

[Video plays]

“What we discovered is that the music itself is audible in the womb…

What we’re hearing is the rhythmic gentle sound of the blood rushing through the uterine artery and this is that, you know, the way nature just allows us to evolve with rhythm all around us, and over that, we heard the sound of the external female voice – that was actually myself singing, standing next to the mother, in a normal volume of voice.

This is exactly what the foetus hears, recorded by the microphone in the womb, and studies show the foetus reacts to music.”

So, there you have got an example. The amniotic fluid which surrounds the foetus is very good at transferring sound, particularly the human voice in terms of the prosodic features of pitch and rhythm, but not very good at transferring consonants. The first sounds that we all heard were musical. Our first experiences as humans were musical. We were listening to someone using their voice. So, using our voice in this way is a very natural process.

In terms of Western culture, we find that when young children arrive at school, they are very quick at picking up the language in terms of the lyrics and also rhythm and then, subsequently, the contour, but the whole business of being very good at the other musical features, singing in tune, for example, can, for some children, take a longer time to actually develop. I am just going to play you some examples now of children. These are all female, they are all aged nine, they are all from the same class, but just to give you a sense of the range of singing ability that you might encounter as part of our journey. So this is “Twinkle, Twinkle”…

[Audio plays]
She has picked up the lyrics, yeah? She has mastered the lyrics. It is the other elements, if you like, of this song that she has not quite got, whereas compared with this example...

[Audio plays]

You can also hear the pop performance in that, can you not? You can almost see her moving.

This is “Happy Birthday” but it always takes me back to Marilyn Monroe...

[Audio plays]

And this is her friend, same class, same age...

[Audio plays]

And what you can also hear in that nine-year-old is a certain embarrassment, already self-conscious. They have already begun to label themselves as “Can’t sing – I’m not a singer,” you know, that is something that someone else does. In fact, they are capable of moving, but because they are in a collective social context in which it appears that some people can and some people cannot.

One of the interesting issues across various parts of Northern Europe over the years, people have started up “Can’t Sing” choirs. There is one been running in South London, south of Waterloo, for many, many decades. A colleague of mine put an advert in a newspaper in Gothenburg and said, “If you think you cannot sing, would you like to come along?” There was this enormous church and she thought she would have a few people in the front pews – she had over 200 suddenly turn up to say “I can’t sing – can I sing?”

In terms of children’s normal singing development - this may look complicated, sorry about that, but it is not.

This is children’s ages, four, five, six, seven, up to 12, and this is children’s measured singing ability. So, in a study I did for the UK Government, I was assessing the impact of a national programme over four years plus. This is the aggregate data of 13,000 children from across England, individually assessed, and then plotted in terms of their age but also as to whether or not they had experience of this Government programme or not. The children that did not have the experience is this line, so you can see, as children get older, they get more experienced and better at this thing called singing – it is a natural process. Most people, by the time that they leave primary school, are competent, whatever that means, but competent enough for us to recognise what they are singing. But here, these are children which are inside the programme, and these children are, on average, two years in advance, but for the younger children, they are three
years in advance – that is to say, five year olds are singing as if they are eight outside the programme. This was, of course, something that pleased the Treasury, that they had actually funded all of this, but we will not go into that. The main thing is that it’s demonstrating the power of education to actually make a difference: we can improve people’s singing ability, irrespective of whether or not they think they are good singers.

Now, in terms of those who have more rich environments, this is just an example of the longitudinal changes in vocal pitch behaviour of a female chorister at Wells Cathedral, where I have been studying these with a colleague, David Howard from York, for many years. Here, this was May ’99, and she was just singing this little phrase, “The truth of God, the God of love,” from a carol, and we have just anonymised the sound here so that is why it is synthesised rather than the actual human voice.

[Audio plays]

You can see, if you just look at the pitch trace, there are lots of gaps. There are lots of moments when the sound does not function, and although we might be hearing those as two similar pitches - this is “The true of...” - you can see that they are similar but not identical.

Here, this is five years’ later...

[Audio plays]

It might be subtle, but you can hear there’s more legato in the voice. There is much more sense of the sound being joined-up, and you can see the legato in that acoustic pitch trace compared with that one. Here, she’s almost kind of singing the words, “The truth of God, the God of love,” whereas she’s singing, “The truth of God, the God of love” – that’s the difference.

When we looked at the variation in the timbre of her voice over this period, we found an enormous amount of difference higher up in the spectrum, which is what this is represented, compared with here, which is the actual pitches themselves being represented. So, the variations in the instability of the singing voice were quite wide, but as she got older, it got better, and this, in part, is because she is singing in a choral setting. I do not know if any of you have the opportunity to see children singing in a cathedral or equivalent setting or to see them rehearsing. What you find, certainly in the rehearsals, is you get a very big one and a little one, and a very big one and a little one, so there is this communal learning going on, that the little ones are surrounded by, if you like, loudspeakers either side of them that is providing the accurate line they are meant to be working on, and also they have got this big colleague next to them pointing out things, passing the pencil, etc. That was a very rich learning environment.

Now, what about the adult population? What about the people in this room? The majority of adult individuals can carry a tune. 10-20% of the general population is inaccurate when singing a melody from memory or in pitch-matching tasks, so somewhere, depending on the task, 80-90% of the people on your bus this evening can sing a tune that you and I would recognise. Occasional singers, people like you perhaps that sing when you have had a drink or when you are in the bath or whatever, tend to sing at a faster tempo and with more pitch and time errors relative to professional singers, but if you ask occasional singers to sing more slowly, they are as accurate as professional singers. This was a lovely study done by a colleague, in which he went into a local park in Canada, and he said, “It is my friend’s birthday – would you mind singing “Happy Birthday” because I am going to play that to him later as a present?” and then he asked some of those people to actually sing again, but a different time, and notice the differences... It is partly to do with identity, that when we ask people to sing, particularly in a public setting like this, “Would you mind standing up and singing?” that there is this sense of “Oh my God, I have got to get it over with quickly - can I escape?!“

In terms of singing and emotion, this goes back to what I was talking about earlier about the human body-mind design. This is a label that was coined, was created, by Candice Pert, a very clever neuroscientist in the States back in the ‘80s, and she was talking about the way that the three bodily systems, the nervous, endocrine and immune systems, are integrated and they work together.
We see this particularly in music, that music is an emotional experience – that is to say, there is not any experience that we have as a human being that does not have an emotional tagging. You cannot say “Oh, I am going to be emotionally neutral about this,” because if we image your brain, the emotional centres are still lit up - even though you think you are being neutral, you are not. Everything that we experience in life has an emotional correlate to it, and we see this particularly in music. So, when people listen to music, we have intense pleasure if we listen to favourite music. We experience this kind of abstract sequence of sound unfolding over time, but this is associated with dopamine activity, which is part of the reward system, and here, you can see, this is deep inside the brain, these emotional centres that are lit up when we listen to music we like, and this is associated with reward. So, when you win the lottery or someone gives you cash, it is your birthday, we get the same centres inside the brain lit up. And this pleasure sequence of dopamine release over time embraces both anticipation and resolution. So, thinking about the concert you are going to go to, we see these emotional centres lit up, even though you are not there yet. We also get changes in heart rate, respiration, electrodermal response, and we get a decrease in bodily temperature and also in the way that the heart pumps itself. So, when we listen to music, we really can calm down and we see this in terms of our normal day.

This is your normal day. You got up this morning and your cortisone was high, your stress levels were high, thinking, “Oh my God, I have got to…oh my God, what’s the time, oh…!” and you have got to get out the door, and we have this high cortisone level first thing in the morning, because we have been asleep, we get up and we are ready to go, and as the day goes on, this gradually decreases.

I compare that here with a choir rehearsal, people arriving in the evening for their choir rehearsal. They are all a bit fired up. Forty minutes later, they are relaxed, they are chilled...

We find this in another study published by a German colleague about group singing, and he was comparing singing here with chatting. What he did was he was, before the session and 30 minutes later, he was actually measuring what was going on hormonally, and we saw an increase being reported in people’s positive feelings and a decrease in their negative feelings, which was not there if you just asked people to chat with each other. This relates to the hormone oxytocin, which was also being measured, which has previously been implicated in intimate social bonding. When you really get on and do something with someone else that you like, that sense of being together is actually because of this hormonal response.

And, in a study you may have seen reported in the Times I think it was, last week or a week ago, there is a slight nuancing of this. Fifteen professional singers, highly experienced, were asked to sing at the same time each evening, same singers, with or without an audience in a concert venue. In the low-stress performance context, there was a reduction in cortisol and cortisone – that is to say, singing without the audience there, they were also chilling out, just like the previous slide, but when the audience were there, even though these were highly-experienced, there was an increase in cortisol and cortisone, so they were feeling stressed even though these were highly-experienced. So, being a professional, and highly-skilled, does not mean to say that you do not experience stress, but it is less in a group context, and the level of stress hormone also impacted on their reported anxiety.

Anyway, what about the other physical benefits of singing in a choir? There is evidence of both short-term and long-term health and wellbeing benefits, and this is for young people as well as older people. Physical benefits include improved vocal and lung function, enhanced mobility and the strengthening of posture. Psychological benefits include distraction, positive thoughts, feelings, positive feelings and emotions. That is just singing with other people. The social benefits include sharing positive experiences with other people, having opportunities for social interaction and social acceptance. It can be quite challenging for older people, particularly if they have lost their partner, and having an opportunity to do something with someone else makes a difference, but singing is adding even more to that because it is this activity which is emotionally engaging as well as being physically enhancing.
One of the other things that you might get from performing in a group is that your anxiety is quite different. If we compare performance anxiety singing as a soloist compared with singing in a group, we see differences. This is just before a performance. This is Western classical soloist. As the performance begins, stress level gets higher. Once they are into the performance, there is a dip, but the same performers, when they are in a group situation, you can see there is the same pattern but it is much less, and we see similar patterns here if these are jazzers or rock musicians or folk musicians. Performing in a group context is a much less stressful thing to do than being a soloist. The distress level here, those that are experiencing distress in a solo performance, the number, the proportion, is almost half, but this drops down to one in ten, with the same people in a group situation. Solo performance tends to evoke high levels of distress, whereas group performance induced low levels of stress. One of the benefits of making music with other people, singing with other people, is that you are making music but in a less stressful context.

One of the wonderful things, from an acoustic point of view, is that the acoustic output of a collective – if we asked you all to sing at the moment – we will not, but if we asked you all to sing at the moment and looked at what the acoustic pattern of that was, compared with each of you signing alone, we get more because the harmonics you are producing become added together, so it is two plus two equals five. As a collective, you sound much richer than any of you singing on your own. The collective voice is different.

In terms of the social benefits, the musical brain is also a social brain. Let us see a little bit of video about that...

[Video plays]

“If you look at music performance, there’s no activity that we do that allows the brain to do so many things at once with such a complicated coordination and with such depth.

But of course music is actually intrinsically social.

Neuroscientist Laurence Parsons asked British rock-stars Jarvis Cocker and Richard Holly to help out with a new experiment.
“Sometimes you’ll be singing by yourself; sometimes you’ll be singing together. It’ll be a bit unusual because you’ll be lying on your back…”

“That’s not that unusual.”

“… and singing.”

“Yeah, that’s slightly more unusual.”

“And the idea of the [sort of new edge] of research is to look at people interacting together while they’re doing music, which is of course what music is about.”

“We’re probably both curious to know whether we had any brain left after many years in the music industry…”

“When you write songs, you don’t really know where they come from, and so it’s kind of…seems interesting to find out what’s going on in your head. It’s always something I’ve been a bit curious about.”

“Yeah, to unravel the mystery of that.”

All of the work published in the past have looked at a single person’s brain doing a single musical experience. It’s worth looking at what brain area is involved when you [really do social ?], in this case, musical performance.

And this is complicated, coordinated social work as well as cognitive work since there’s a lot of millisecond decision planning as you go along.

When he analysed the scans, Parsons did find differences in brain activity when Cocker sang alone compared to when he sang with Holly playing guitar. During the duet, Cocker’s brain was more active in areas for phrasing and coordinating music, as well as cognitive and emotional interaction.”

And so, what you can see here is that, on the left-hand side of the screen, this is when he was singing on his own, and on the right-hand side, when he was singing with someone else, another human being, and there’s this need for reciprocity, for empathy, so there’s part of the brain which is a social brain, which gets switched on when you make music with someone else, and if you’re in a choral setting, you see it even more so.
The social benefits of singing were also part of that earlier study I mentioned where we were evaluating this Government programme, Sing Up. We gave all of these children questionnaires asking them about what they thought about singing, but within that, we also gave them some questions about social inclusion, about their sense of belonging, about feelings of being part of a community, and what we discovered was that there was a clear correlation between children’s singing ability and the extent to which they were reporting themselves as being socially included. So, children that were most socially included tended to be the best singers. Those children that were less good at singing tended to see themselves as less socially included, more excluded, more on the fringes, and when we did the statistical analysis, the data was being driven in that direction, [i.e.] the singing ability was related to people’s sense of connection within the class. We saw this whether people were inside the programme, which is the green line, or outside the programme.

I then repeated the questionnaire in Italy, at the invitation of the Italian Government. They had had a programme in which they had choirs in schools the previous year, and so we translated the questionnaire into Italian, gave it out to these children, and compared the children – we got boys and girls - with their peers who had not taken part in the choir programme. This is one year later. The children that had taken part in the programme were reporting themselves as more socially included than those children outside this particular choral programme.

We also did an evaluation of the Choir Schools’ Association’s Chorister Outreach Programme. They had received money from the Government, the cathedrals, to go out into local primary schools to actually encourage children in the primary schools to sing, and what we found was that those children had the highest positive mean attitudes to singing, those that had experienced singing with the choristers, the strongest reported engagement with singing, and the highest average social inclusion score.

There is just a little video clip now, just to give you an example of the way that singing as a collective is strongly involved in emotional engagement...

[Video plays]

A typical African chorus activity when you have someone leading and someone responding...

Notice, it is difficult for you to sit still while you are watching this...just demonstrating you are human...

So, that just gives you an example of what music is like.

Now, what about singing and disability - do you have to be a particular special kind of person to be able to sing and/or sing in a choir? Well, this is a little film clip from a TV show which has a deaf choir...

[Video plays]
It is Hollywood, is it not, but it gives you a sense of what might be possible, and I have been working with some colleagues from UCL in a primary school just about 20 minutes from here. This is a school which is unusual because it is got a large number of hearing-impaired children in it that come from all over North London, and we have been working with children aged five to seven years, and we implemented a 20-week singing programme for them. Here, you can see, these are their normally-hearing peers, which we tested on their singing skills at the beginning of the 20 weeks and then at the end of the 20 weeks, and you can see that they are similar – there is some general improvement, the range has reduced. Here, you can also see, the children that are wearing cochlear implants and likely hearing aids, that these children have also improved – the diversity is much improved. We also found that the children’s pitch range – this is the normal hearing, and these are the children in the hearing-impaired group – that doing singing activities have given them many more semitones - this is the singing range - so, their voices had expanded. We also found, when we gave them a pitch discrimination test, that, at the beginning, most of them could not do it at all, apart from an odd couple here, but then, after ten weeks, there was an improvement in pitch discrimination, and then an improvement again after another ten weeks. So, working with children with severe and profound hearing impairment in a collective singing activity, there seems to be a wider benefit.

What are the conclusions that we can draw from this? Well, we know that artistic behaviour, as I said earlier, involves many different parts of the brain acting simultaneously, and successful involvement in the arts will embrace an integrated neural functioning and potential near and far transfer, so to say, near transfer in music, far transfer perhaps into other areas of function, including a sense of social inclusion, and benefits are possible across the lifespan.

For the European Concert Hall Organisation, I discovered that, in one 12-month period, there were over 570,000 children and young people and adults and seniors that were experiencing music, all over Europe, as part of an education and learning programme that these concert halls were running, as well as their ordinary music programmes.

Basic neuropsychobiological design and maturational development, the way that we are designed as humans, are mediated by sociocultural imperatives. That is a fancy way of saying experience changes us...

Particular musical behaviours become more or less developed.

We know that learning happens within a social process, such as being part of a choir.

Singing development is possible across the lifespan. We have got evidence of 80-year-olds singing in choirs. In Australia, one of my colleagues is now running choirs for 90-year-olds. That is a few years yet for the rest of us to join in.

But negative experience can hinder or halt singing development and impact negatively on our singer identity.
So, what about singing in a choir? Singing with other people brings a wide range of benefits, especially physical, psychological, including emotional, and social. This is in line with the kinds of benefits that accrue from other kinds of successful group music-making. I have been evaluating instrumental programmes for children, for example, 10,000 children in East London learning an instrument at the moment. But it is likely to be more marked for singing because the human voice is an integral part of our identity, of who we are. As soon as you open your mouth, we know something about you, and your voice-print, should we be into forensic voice science, is unique, just like your fingerprint. Your voice is unique – no one has a voice like you.

Thank you very much.

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