Music, art, and the brain

Professor Keith Kendrick

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The aim of this lecture is to consider the general questions:

- Are musical and artistic skills adaptive?
- What makes the brain responsive to music and art?
- Are the brains of highly artistic individuals different in some way?
- Is listening to music or learning how to play it or sing beneficial to mental functioning?
- Are music and art unique to humans?

The influence of music on everyday lives in the modern world

More money is spent on the products of the music industry than on pharmaceuticals. Indeed the largest export industry from the USA is not 'high technology' but entertainment and of that the largest component is music. The roads of almost every country are music super highways as we all listen avidly to music while we drive in our cars or other forms of transport. The world is full of CD and MP3 players and a huge variety of musical instruments, instrumental music and songs. Music is used to help make us happy, calm us down, make us aggressive and competitive and comes second only to using friends and self-motivation. It is difficult to imagine what life would be like without music since for the vast majority of us it is an integral part of our lives.

Our ability to appreciate and respond to music is evident from birth and even in the developing foetus

Not surprisingly the best known and best selling songs are those that become part of our every day lives, although it might not occur to everyone immediately that the number one song in the majority of cultures was written by two ladies who are virtually unknown – the song is of course "Happy Birthday" composed in 1893 by Mildred and Patti Hill.

As we will see in a moment, music may be the oldest art form in humans and most anthropologists seem happy to conclude that music has been a part of all human cultures that have ever existed.

The influence of other forms of art

There are, of course many different forms of art that one might consider although the visual and performing arts clearly have a major impact on the lives of most of us. Whether we are talking about paintings, sculptures, poems, plays or even films that we consider artistic the key defining feature that they have is that they are in some way independent of reality, or distortions of it, although they are capable of evoking ideas, thoughts and emotions that are real and can relate to the real world whether external or internal. Art is representative of reality without being entirely real. The main appeal of celebrated artists is that they find novel and often unexpected ways to achieve this. So the art we seem to respond to most strongly is that which we can readily interpret into something real, even if it appears to be totally abstract or completely distorted. As Pablo Picasso has said:

“Art is a lie that makes us realise the truth”

If we are unable to interpret the truth that the art represents then it has no purpose other than as a pure sensory experience which rapidly loses its novelty value. Even films and television programmes are hardly real – if they were we probably would not want to watch them. Arguably, reality television shows are deliberate distortions of life as well, although I doubt any one would seriously want to call them artistic. And of course for many what we call art, and what we do not, is a very subjective thing. It is highly experience and culture dependent. One only has to view the works considered for the Turner prize each year to realise this!

The evolution of artistic brains in humans

Darwin concluded in “The Descent of Man”:

“As neither the enjoyment nor the capacity of producing musical notes are faculties of the least use to man in reference to his daily habits of life, they must rank among the most mysterious with which he is endowed.”

On the face of it there is no easy way to ascribe any major adaptive advantage to developing artistic faculties in any species. Yes, one can perhaps suggest that being able to draw pictures can aid communication between individuals about how to find things. Tribal music could also help with social cohesion and bonding and individual qualities in playing music and singing could be seen as an important aspect of courtship behaviour.

Most would feel comfortable in maintaining that artistic representation and music composition along with language, are unique features of human evolution. However, it does seem that, as I have argued in a previous lecture on language, that some of the rudiments of representational art and musical interpretation are present at least in some other primate species. Many of us will also have experienced dogs seeming to join in with apparent attempts to accompany human singing and birds, gibbons, whales, dolphins, bats and even mice produce songs, or something that appears to closely resemble them.

The oldest musical instruments that have been found are bone flutes. Incredibly the oldest of these found dates back to between 43,000 and 82,000 years and made from the femur of the now-extinct European bear. This is back into the Neanderthal period and suggests that not only did music predate Homo sapiens but it may also have predated the use of paintings – the oldest cave paintings do not date back even half as far as this. It may also predate language which many have suggested only evolved with homo sapiens (see Mithen, 2005 “The Singing Neanderthals”).

Some scientists have suggested that music may have evolved as far back as 250,000 years ago!

This kind of time period does allow the possibility that musicality could have been selected for as an evolutionary trait and therefore have a genetic basis. The debate as to whether musicality confers any specific survival value has been quite intense and continued over a long period.

Many experts have put forward the view that music has no survival value and some philosophers have argued that a defining feature of the arts is that they serve no practical function. This has led to the development of theories that it is non-adaptive or some form of evolutionary vestige.

Non-adaptive pleasure seeking theory (NAPS)

Pleasurable activities that have survival value, such as eating, drinking and sex, all link strongly to reward centres in the brain to encourage their expression. The NAPS theory hypothesises that it is possible for other non-adaptive behaviours to link into this established system. A classic example of this is taking drugs like heroin or cocaine. So perhaps music is just another example of something non-adapative that is also capable of activating these same pleasure centres (certainly we know from brain imaging studies that pieces of music that we enjoy intensely do activate brain reward areas). This is the kind of argument that the language expert Steven Pinker makes when he describes human responses to music as a kind of “evolutionary cheesecake”.

An argument against this suggestion is that NAPS behaviours tend to be short lived because they are not adaptive and will not selected for. However, music has been around for a very long period of time which suggests that it is adaptive.

Music as an evolutionary vestige

The idea here is that while musicality did once have survival value and was selected for, it no longer fulfils a useful purpose and, like the appendix, has become irrelevant in this respect. For this to be a possibility it is of course necessary to identify the survival value it did have and to show how that is no longer of importance.

Evolutionary theories of music and art

It does seem possible to suggest some adaptive functions that musicality or other artistic abilities may serve. The following are the most popular and also take into consideration whether species other than humans have human-like musical or artistic abilities.

Mate selection – It is possible that just as some species have selected for highly colourful or ostentatious mates – peacocks for example – music making might have evolved as a courtship behaviour which in some way provided a good indicator of the prospective fitness of the individual either singing or playing to a prospective mate. This has considerable support of course from evidence in other species such as birds and whales where song quality and complexity can sometimes be the deciding factor on what turns a girl’s head.

Darwin himself put forward this sexual selection theory of music in his book “The expression of the emotions in man and animals” published in 1872. Miller (2000) has suggested that sexual selection accounts for why musical interests appear to peak in adolescence. However, sexually selected traits tend to be gender specific and there is no strong evidence that male and female humans show different musical abilities.

Nevertheless, most other animal species that sing do so primarily in the context of courtship and it is usually the males that take the lead. So maybe there is some justification for the serenade after all. Singing mammals however are quite rare in comparison to birds where it is well established as a courtship device and a sign of fitness. Even Mozart is said to have been impressed by the songs produced by birds and may even have used some examples in his music. Some have even gone as far as to suggest that humans learned to imitate song from listening to the birds!

However, as far as mammals go the most celebrated songsters are gibbons, bats, dolphins and whales and here also one of the main contexts is attracting a mate. Perhaps the most bizarre recent example is the recent published work on “singing mice”. It has been known for some time that male mice produce ultrasonic vocalisations in the context of sex. It appears that just a female’s urine smell will make them burst into song and each mouse has his own version and it consists of repeated sequences of differently pitched “chip-like” syllables – i.e. rather like bird song. What effect this has on the female though has yet to be addressed.

One of the most important pieces of required evidence to support this theory would be to show that more musical and artistic individuals were more successful in passing on their genes. Of course both today and for the vast majority of artists and musicians in the past their talents have not usually brought them personally great riches and, for males at least, resource provision is a potent feature of attraction for females.

However, a paper just published in the last week has produced evidence that poets and other artistic individuals are likely to attract more sexual partners (Nettle and Clegg, 2005). In theory at least this might translate into such individuals promoting their genes through producing more offspring. But there is no real evidence that any of our cultures are producing more musicians or artists as a result of this. Nevertheless this seems a good opportunity to point out that I am a poet as well as a scientist!

Grooming, gossip, social cohesion and bonding

By far the most persuasive hypothesis for the possible evolutionary origins or music, and perhaps some other forms of art as well, lies in the area of social bonding and cohesion. Music appeals to, and controls, our emotions in a very powerful way and either listening to music as a group or, particularly, singing songs or playing music as a group is a fantastic way of synchronising the types of emotions each of us are experiencing and whipping them up into an intensity that might be difficult to achieve by an individual in isolation.

One social evolutionary argument that has been put forward is that the extent to which group sizes can become larger in any particular primate species is dependent on the efficiency of being able to maintain social cohesion through bonding behaviours. The main way of achieving this in primate societies in the absence of language is grooming – or in the special case of Bonobos grooming and sex. These are one to one behaviours and if each individual has to groom most other individuals then it can readily be seen that this prohibits group sizes from becoming too large because otherwise there would be no time for anything else. As one would predict from this hypothesis individuals in larger social groups spend more time grooming than those in smaller ones.

Scientists such as Robin Dunbar have argued that the evolution of language may have been spurred by the fact that this allowed simultaneous bonding with more than one individual. It is argued in fact that the maximum comfortable size for vocal communication in groups is four. Groups larger than this tend to break up into smaller ones quite quickly. So “gossip” bonding should, according to this theory, allow perhaps a four-fold increase in primate group sizes that can only use “grooming” bonding. Interestingly enough this plays out quite well with estimates of average human group numbers in primitive societies being around 150 compared with 30-50 in other primate species.

The use of music and group singing could also be regarded as an even more efficient way of providing social cohesion in large groups of humans and you can see that in evidence every Saturday in football grounds or other sporting or competitive events. One might even go as far as arguing that music has helped to promote the evolution of large scale conflicts in human societies since all cultures seem to use it extensively as a way of engendering fighting spirit simultaneously in large numbers of individuals in armies. However, on the other side of the coin slower, listening to or singing more pacific music is also a good way to defuse tension and aggression in social groups. And finally, of course, the ability of music to turn thoughts to romance is well recognised and exploited.

The relationship between music and bonding behaviour is to some extent supported by observations from individuals with William’s syndrome – which is associated with high levels of social and bonding behaviour – or Asperger’s – which is associated with low levels of social and bonding behaviour. Individuals with William’s syndrome tend to be highly musical whereas those with Asperger’s are not.

To date very little work has been carried out investigating the effect of music on hormonal and neurochemical release. One recent study has shown that calming music significantly decreases male testosterone levels which should help to reduce aggression. There is speculation that music might also stimulate the release of bonding hormones such as vasopressin and oxytocin although this has yet to be shown.

The left, right and centre of the musical and artistic brain

There has been a large increase in the number of studies investigating how the brain processes differing aspects of music and music interpretation, although we are still a long way from a full understanding of this area since it is every bit as complex as language. I will not attempt any kind of detailed review of this field but instead will just focus on broader aspects of what has been found and also some general principles of brain organisation that makes art appeal to the brain.

What is it about successful works of art that appeal to the brain?

In his Reith Lectures in 2003 the Neurologist Vilayanur Ramachandran proposed a tentative list of ten laws of art which have resulted from the way that the brain has evolved to detect and discriminate important objects in our everyday lives. These were:

- Peak shift
- Grouping
- Contrast
- Isolation
- Perception problem solving
- Symmetry
- Abhorrence of coincidence/generic viewpoint
- Repetition, rhythm and orderliness
- Balance
- Metaphor

Peak shift - has to do with the brain finding it easier to interpret exaggerated versions of learned objects. A classic example of this is caricatured faces which the brain appears to be more responsive to than real faces. Indeed we are often quicker in recognising caricatured faces of famous individuals then we are with real versions of them. Art is full of exaggerations of form and motion to promote an enhanced response to images or sounds. A classic example is voluptuous paintings and sculptures of women.

Grouping – The brain is designed to try to make sense of chaos and this is well illustrated by visual illusions. It is particularly good at filling in the blanks or grouping similar shapes or colours. A classic example of this is the dalmation dog picture originally used by Richard Gregory in his books on visual perception. The argument goes that living amongst the trees and undergrowth our ancestors had to develop expertise in detecting the presence of both predators and prey from impoverished perceptual cues such as an animal hiding in the bushes.

Contrast- aids the identification of objects against whatever background they are in. Once again the brain is designed to pay particular attention to contrast contours.

Isolation (or understatement) – like peak shift and grouping this refers to the brain's ability to interpret represented or obscured objects in a highly efficient way. In this case though it refers to the fact that the brain readily fills in the blanks when presented with crude representative shapes to come up with highly accurate interpretations of the real object that they represent – like an oval shape with two dots and a semi-circle drawn within in to represent a face

Perception problem solving – refers to our motivation to solve perceptual problems which seems to be a pleasurable experience. The visual areas of our brain for example are closely linked in with areas controlling emotional responses and reward. As Ramachandran points out this might, for example, have kept men highly motivated to chase elusive mates or work out what was underneath the various disguising coverings they might have worn!

Symmetry - we find symmetry in objects highly attractive and this is particularly the case with faces and body shape – as I discussed in my lecture “Addicted to love, beauty or sex” on 14th February 2005.

Abhorrence of coincidence/generic viewpoint - We are not so fond of the obvious and expected.

Repetition, rhythm and orderliness – We do find these aspects of objects attractive probably for the same reason we like symmetry.

Balance – As with orderliness we tend to feel uncomfortable with things that exhibited a disproportionate bias in one place compared to another.

Metaphor – This is also another example of our pleasure in solving problems. We are often attracted to poetry literature and paintings where something new can be used to represent and characterise another more f ami liar object.

The musical brain

In my previous lecture on the different functional specialisations of the left and right sides of the brain I showed that language for the majority of us is controlled primarily by the left side of the brain. The tonal component of language on the other hand is controlled mainly by the right side of the brain and the same appears to be true for much of our response to and even memory for music.

There have been some claims that with professional musicians the left side of the brain comes more into play, the assumption being that the syntax of music is rather like language and that is why the left brain hemisphere becomes more involved. However, not all studies have replicated this although it has become increasingly clear that for all individuals certain aspects of music involve both sides of the brain. Indeed, if music appreciation and performance was strongly dominated by the right brain hemisphere this would predict a male advantage for this as with aspects of spatial tasks. No study has reported any significant difference in musical ability or sensitivity between the sexes other than the fact that females are more sensitive in detecting sound.

Perhaps the simplest example of the complimentarity of the two sides of the brain in relation to music is the observation that when we hear a tune we tend to use the right hand to tap its rhythm and the left to tap its beat. The right hand is controlled by the left hemisphere and the left by the right. This suggests that the left hemisphere is more concerned with temporal aspects of the fine syntactical structure of the tune and the right with its overall structure.

The auditory system is arranged tonotopically right from the level of the basilar membrane in the ear to the primary auditory cortex in Herschl’s gyrus. By this I simply mean that different frequencies are represented by different spatial regions of these structures in a kind of sequence from low to high. This organisation is probably one reason for why we can find two sounds of similar tones played together quite uncomfortable – dissonance – compared to those further apart – consonance. The dissonant sounds set up competing activity patterns in adjacent processing regions.

Interestingly, the right auditory cortex is more tightly tonotopically organised than the left which may explain why detection of pitch, and particularly the development of perfect pitch, appears to be based more in the right hemisphere than the left.

Not surprisingly the music interpretation system in the brain is quite extensive and involves structures controlling memory and emotional function as well as those just dealing with different aspects of sound.

Music and memory

Memory for songs and music is an absolutely essential part of our ability to respond to it as well as to perform it. We have a remarkable ability to remember complex tunes and songs and both music and rhyming schemes in poetry give us improved abilities to remember lengthy sequences of words. I am sure that most if not all of you listening to this lecture could recall the precise music and lyrics to a host of nursery rhymes learnt as a child but I doubt many could remember anything else from that same period of your life as accurately.

Memory for music does seem to be dissociable from memory for other things such as words and objects. Evidence from brain imaging experiments and from individuals with brain damage show that the frontal cortex is particularly involved with memory for music and that brain damage which impairs ability to remember melodies does not always affect other aspects of memory. In this sense it is rather like face recognition which can similarly be dissociated from other forms of visual object recognition.

Music and imitation

We are all well aware how easy it is to imitate singers and songs, even to the extent of miming them. Recent studies have revealed that parts of the brain that are involved in both language production and imitation, such as Broca's area, are also involved in responding to music.

Music and emotion

Surprisingly, relatively little work has investigated how music is linked to emotion in the brain even though it is well recognised that the effects of music on emotion are very strong. The most extensive studies have revealed that musical pieces that evoke intense pleasure and send "chills" down the spine activate many of the same brain regions as do sex and drugs like cocaine. These include the dop ami nergic reward areas such as the nucleus accumbens and other emotional control and response areas such as the orbitofrontal, insula and cingulate cortices. Similarly musical dissonance has also been found to activate cortical and sub-cortical structures associated with negative emotions and particularly in the right brain hemisphere although, surprisingly, not the amygdala which is involved in most other contexts. The fact that brain responses to music particularly involve the right brain hemisphere, and this is the hemisphere that is mainly involved in responding to stimuli that evoke intense emotions and associated autonomic changes, obviously further underlines the important link between music and emotion.

Congenital amusia

There was an old fellow of Sheen
whose musical sense was not keen.
He said: "It is odd,
I can never tell 'God
save the weasel' from 'Pop goes the Queen'.

Some very famous individuals have been virtually completely tone deaf and include Ulysses S Grant, Theodore Roosevelt and Che Guevara. Grant once said to a reporter: "I only know two tunes. One of them is Yankee Doodle and the other isn't." Indeed, music apparently annoyed him. It seems that some individuals are congenitally impaired in being able to distinguish and respond to music and songs and this can be quite independent of language ability. This condition has been termed "Congenital amusia" and is suggested to be a developmental disorder similar to a specific language disorder such as dyslexia.

It is thought that this condition primarily affects the organisation and functioning of the auditory cortex itself in the brain and this is why its effects are so wide ranging. The assumption is that this is a genetic disorder which, if true, would lend considerable support to the argument that musical ability is adaptive rather than some kind of non-adaptive accident. Amusia does indeed seem to run in families and a recent large-scale study that investigated the relative abilities of monozygotic and dizygotic twins to recognise a single wrong note in a musical piece found much greater concordance (70-80%) between the monozygotic individuals – indicating a strong genetic link.

Are specialisations for music and art unique to the human brain?

The simple answer to this is that, rather like language, we don't really know. Yes birds and mammals someproduce and respond to songs and may even imitate human music. They may even show similar emotional responses to different types of music in the way that we do. But the question of whether they have similar specialised brain systems for music to us is far more difficult to determine.

Probably the most logical conclusion is that they do at least to some extent, because brains have evolved in different species using similar principles and quite possibly our development of musical abilities and responses has resulted from an accident of brain design that evolved for an entirely different purpose. Recent work in the USA has, for example, shown that monkeys also have at least some of the same innate abilities as we have for discriminating music including octave generalisation (Hauser and McDermott, 2003).

With representational art this requires a degree of cognitive sophistication that is hard to find in other species. The idea of using one object to represent another implies a grasp of symbolic concepts along the lines of language. There are a number of examples of Chimpanzee art produced by language trained apes such as Washoe. These might, I suppose, result in serious consideration for a Turner prize but it is difficult to see them as anything more than colourful doodles!

Does listening to Mozart or learning to play a musical instrument aid memory?

Both scientists and the media have combined to promote considerable confusion about the short term consequences of listening to music and the long-term consequences of formal training in music. They have combined to reach a conclusion that many would like to sign up to – namely that both prove the adage "music makes you smarter". This whole phenomenon is perhaps one of the most classic cases of "wishful" thinking where a relatively simplistic scientific finding published in a high impact science journal, and trumpeted by the media, has spawned an apparent fact and an associated industry that promotes the benefits of playing "Mozart" to humans from conception to death! As we will see there is little hard experimental support for anything as simple as this, and certainly nothing particularly special about Mozart – other than the pleasure that his music gives to many listeners and players.

The origins of the Mozart effect

The story all stared with a short paper published in Nature in 1993 by Frances Rauscher, Gordon Shaw and Katherine Ky from the University of California at Irvine. Here thirty-six students were given standard IQ spatial reasoning tasks to complete having being exposed for the previous ten minutes either to Mozart's sonata for two pianos in D major K448, a relaxation tape or nothing. Overall this resulted in spatial IQ scores of 119, 111 and 110 respectively in the three conditions, although the effect only lasted for 10-15 minutes. Listening to the Mozart sonata had therefore resulted in a modest and transient increase in spatial IQ of 8-9 points – interestingly about the same level of difference reported between males and females on this aspect of IQ (see my previous lecture on “The Left, Right and Centre of Male and Female Brain Politics” October 2005).

Rauscher and her colleagues extended these findings slightly in another paper published in 1995 where they used a spatial and temporal paper folding task and found that again there was a short term advantage of listening to the Mozart sonata (for several days this time) that was not seen in more repetitive kinds of music or stories. There was no advantage after listening to Mozart for remembering the sequences of visually presented objects. They proposed that since Mozart started composing from the age of four he might have produced music that was particularly attuned to the rhythms of his developing brain neocortex and that this was reproduced in the listener and led to temporary improvements in some aspects of memory. They conclude the paper by writing:

“Perhaps the cortex’s response to music is the ‘Rosetta Stone’ for the ‘code’ or internal language of higher brain function”

There can surely have been few other examples where such limited and poorly controlled experiments have become accepted as general scientific fact. A simple experiment showing that one piece of music composed by Mozart was associated with a short-term enhancement in a few tasks involving spatiotemporal memory in adults became rewritten as a fact that listening to any of Mozart’s music would enhance all aspects of cognitive and intellectual functioning and would produce most marked effects if started with prenatal infants. Truly amazing!

Even the original authors of these studies are quick to point out how much their work has been misrepresented. Also, a number of other research teams have failed to replicate the original findings, although others have. The improvements in spatial reasoning tasks have subsequently been found to occur with other kinds of music from Schubert to popular songs. What all these kinds of music have in common is their ability to generate a positive mood state. In general music that evokes a sad mood is not beneficial in this respect so, for example, listening to Albinoni’s “Adagio” did not improve performance compared with just silence.

One explanation that has been put forward is when music evokes a positive mood state it causes release of neurotransmitters such as dop ami ne within the right brain hemisphere. This hemisphere is particularly responsive to music, involved in mediating intense emotional responses and in controlling performance on visuospatial tasks. It is also well known that any positive emotive situations can improve cognitive performance.

However, at this point in time it is important to make it clear to everyone that there is absolutely no good experimental support for the idea that simply listening to music will make you “smarter”. This is not to say that there may not be many other emotional and enjoyment benefits!

The advantages of playing an instrument

By contrast with listening to music, music instruction and learning to play a musical instrument has been associated with a number of more lasting beneficial effects.

Spatial-temporal ability: A large number of studies have shown that music instruction, learning to play the piano and singing and rhythm training all improve performance on spatiotemporal tasks but not on verbal, matching and memory tasks. However, the age at which instruction starts and the duration of training both affect how long this advantage lasts. In general it appears that if training starts before the age of seven, and lasts at least two years, then the spatial task performance advantages are long term.

Mathematical ability: There have often been claims made about similarities between music and mathematics and some studies have now supported this. A study on 7-9 year old children showed that piano keyboard instruction improved proportional reasoning (Graziano et al, 1999). A more recent study by Rauscher's group has also found that two years of piano instruction in at-risk children also resulted in higher scores on standardized arithmetic tests. Other work has shown that children receiving singing instruction perform better on mathematical reasoning tasks. However, it is difficult to control for all aspects of educational experience and background and more studies will be needed to establish the link between music training and maths for it to be fully accepted.

Nevertheless, a recent brain imaging study has shown that music training accentuates activity in the fusiform gyrus and prefrontal cortex and decreases that in the parietal cortex during performance of mathematical tasks (Schmithorst and Holland, 2004).

Reading: A meta-analysis of many different studies and often involving over 500,000 students has concluded a reliable positive association between music training and reading test scores. However, a direct causative link has not been shown and indeed may be difficult to achieve.

Music, brain waves and gestalt processing

While it is tempting to speculate that the various different frequencies of brain rhythms might be in tune with the kinds of music that have the most impact on us, there is little work so far suggesting this is the case. Relaxing music does have a slower tempo which corresponds to the slow theta and delta waves that develop in the brain as we fall into sleep. Correspondingly arousal evokes higher frequencies of alpha waves. However, specific relationships between brain wave frequencies and music have not been investigated in detail.

Perhaps the most interesting possibility is that music might promote holistic processing in neural networks. Unlike language, and many forms of object recognition, music involves more holistic processing as a form of gestalt. Indeed it has sometimes been proposed that this is what the right brain hemisphere is particularly good at doing and that it also analyses faces using this principle. This leads to a possible prediction that brain networks processing music may involve more holistic global processing similar to the kinds of correlation shifts and pattern changes I discussed from my own work in my lecture on "Just how does the brain work, and can we design machines the same way?" in May 2005. However, this kind of processing is not easy to investigate with current brain activity recording methods in humans and so it may have to wait for such technology to develop or the possibility that it might work the same way in other animal species exposed to music.

Is there anything special about the brains of artistic individuals?

Since it is clear that not all of us can become concert pianists, composers, artists, sculptors, poets or writers there must be genetic as well as experiential contributions to creating an artistic mind. However, discovering what may be responsible for these gifts is no more easy that studying Einstein's brain to determine what may have caused his mathematical genius. Unsurprisingly, playing musical instruments like pianos and violins does alter the representation of fingers in the motor and somatosensory cortices and there are also changes in many motor control regions of the brain such as the cerebellum. Indeed, the changes that are caused can sometimes lead to problems. Around one in a hundred musicians develop a condition called dystonia where the control of two fingers becomes fused so that they cannot function independently. This seems to be caused by the expansion of the representation of the two fingers in the brain resulting in their overlapping with one another and becoming integrated.

Musicians seem to have more connectivity both within (white matter) and between (size of corpus callosum) the two brain hemispheres. In theory at least this would make them potentially display the same emotional and social attribute advantages that women have over men. So perhaps musicians are more in touch with their feminine side.

It is easy to speculate that gifted individuals in the arts may have particular predispositions in perceptual, motor control and emotional domains which both motivate them artistically and give them the most appropriate skill sets to develop artistic talents. But is there anything that makes an artistic brain experience the world differently from a less artistic one?

Synaesthesia

One of the obvious features of artistic minds is being able to somehow experience the world in a different and meaningful way than other people. It seems that the way the brains of some individuals are wired up to cross link different sensory experiences may help contribute to this.

Imagine what it would be like if music was not just heard but could also be seen in terms of colours and felt in different parts of your body, or alternatively if specific words always triggered a simultaneous sense of a particular flavor or colour. Life might be seen as a rich and complex experience but would also be more than a little confusing and an exhausting state of sensory overload at times.

This condition can indeed happen in humans and has been called “synaesthesia” (literally syn = together + aesthesis = perception) and was first reported by Francis Galton in 1880. Most recent reports suggest that it occurs in between 1 in 200 and 1 in 20,000 individuals, depending upon how strict a definition is used. In its most common form individuals see specific graphemes (numbers or letters) as coloured (even though they are not) although which colour is seen varies from individual to individual. However, the 5 senses allow for up to 20 different varieties of synaesthesia involving two senses and most of these have been reported. The main examples are sounds evoking visual experiences of colours although some bizarre combinations have been reported such as a man who experiences tastes as shapes and a woman who experiences different musical instruments as tactile experiences in different parts of her body (see Cytowic, 1993).

One thing that is most common is that visual experience is evoked by one or more of the other senses rather than the other way around.

Not suprisingly this condition has often been associated with artistic individuals – Vladimir Nabokov, Olivier Messiaen and Alexander Scriabin for example. A recent report has even suggested that 23% of 358 fine-arts students surveyed reported experiencing synaesthesia.

It is clear that synaesthesia is likely to result from a number of different causes and at a number of different levels in the brain (both perceptual – low-level synaesthesia and cognitive – high level synaesthesia – Ramachandran and Hubbard 2001). Although it is difficult to provide definitive principles for what is going on, the most likely explanation is that in most cases there is cross-wiring between adjacent areas dealing with analysis of different sensory information. Thus our sensory maps within the brain may occasionally overlap.

Simon Baron-Cohen at the University of Cambridge has hypothesised that intermixing of the senses is actually normal in human babies in the first year of life and this is supported by brain imaging studies which show broad overlapping patterns of activity with different sensory stimuli. In both humans and other animals there is a physical pruning of brain connections during early development that reduces interactions between sensory areas of the brain.

However, it is clear that experiencing synaethesia is neither necessary nor entirely predictive of artisitic leanings. The idea though that artistic brains are somehow wired up differently from non-artisitic ones has a certain logical appeal.

Some finalconclusions:

Music sells more than drugs – more “Happy Birthday than Prozac”

Art is a lie that makes us realise the truth

Music could have evolved 250,000 years ago

It could just be “evolutionary cheesecake”…

But it could help mate selection and bonding

Poets have greater pulling power.

Artists may use their right hemisphere more.

But both sides get in on the act.

Music processing structures in the brain may be distinct.

Musical sense is not always keen.

The brain is designed to respond to representational art.

Other species may respond to music as well.

Listening to Mozart does not make your smarter.

But music instruction early in life might help

If you see sounds and taste shapes you may have an advantage

But…..very few artists make money!

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