



Music and the brain

By Trevor Eddolls

Why sax and violins are good for you!

Almost everyone likes music, and many people find themselves humming a tune to themselves when doing some boring tasks. People have a favourite genre of music, and many couples have 'our song'. But why do people like music and is it good for us?

What's happening in the brain?

Like all sound, music is heard by the ears and converted to electrical messages that go along nerves to the brain. Once in the brain, music seems to be 'decoded' by many different parts of the brain. The part of the brain associated with sound is the auditory cortex, which is located at the upper sides of the temporal lobes of the brain on both sides. The auditory cortex is divided into the core, the belt, and the parabelt.

So, what's going on in the brain when it hears music? The auditory cortex is stimulated, as we said, in addition, when listening to emotional music, the parts of the brain involved in emotion are activated and become synchronized. Music also activates a variety of memory regions. In addition, music activates the motor system. This, it has been suggested, allows us to pick out the beat of the music before we start tapping our foot.

Talking of which, music will usually have a rhythm, ie a pattern of beats or sounds and silence (rests). These are recognized

by the belt and parabelt. When a person creates a rhythm by tapping or banging, the motor cortex and cerebellum are also involved.

Pitch refers to the frequency of a sound. Tone refers to the colour or timbre of a note. It can be described as warm, strident, rich, etc. The brain uses the auditory cortex to recognize and understand pitch and tone. The auditory cortex also analyses a song's melody (defined as a satisfying sequence of notes) and harmony (defined as notes and chords that sound good together). The cerebellum and prefrontal cortex may also help with this.

The brain also seems to anticipate what will happen next in a tune and is pleased when it is surprised by smart quirky changes. It's the prefrontal cortex that's used for this analysis. The brain also remembers music. People can often recognize tunes after only a few notes (beating the intro!). The hippocampus is responsible for processing information that is stored in long-term memory.

When people read music, play an instrument, or even dance, the parts of the brain that are used include the cerebellum, the motor cortex, the sensory cortex, and the visual cortex. As mentioned earlier, the other thing about music is that it can trigger feelings. There are three areas of the brain associated with these emotional responses. They are the nucleus accumbens (part of the basal ganglia), the amygdala, and the cerebellum.

Mas-Herrero *et al* in an article entitled “Unravelling the Temporal Dynamics of Reward Signals in Music-Induced Pleasure with TMS” in the March 2021 issue of the Journal of Neuroscience, found that communication between the brain’s auditory and reward circuits is the reason why humans find music rewarding. Using fMRI scans, they found similarities between how the brain’s reward circuits processed music and other rewards such as food, money, and alcohol. When they excited the reward circuit prior to playing music, it increased the pleasure participants felt listening to the songs. If they inhibited the reward circuit, participants felt less pleasure. These induced pleasure changes were linked to changes in activity in the nucleus accumbens.

Various studies have shown that all people, including non-musicians, have some musical ability. Koelsch *et al* (2000) found that the human brain extrapolates expectations about what notes are coming next and these predictions are consistent with music theory rather than random. Koelsch *et al* (2002) also found that people can still hear music even when they are not paying any attention to it.

The right hemisphere of the brain seems important when listening to music. Stewart *et al* (2006) found that lesions following cerebral damage led to impairments in the appreciation of pitch, timbre, and rhythm. And brain imaging studies by Blood *et al* (1999) found that the right hemisphere is preferentially activated when listening to music in relation to the emotional experience, and that even imagining music activates areas on the right side of the brain.

Is music good for you?

So, what are the benefits of listening to music? A 2020 survey by the American Association of Retired Persons (AARP) on music and brain health found that:

- People who listened to music had higher scores for mental wellbeing and slightly reduced levels of anxiety and depression compared to people overall.
- Also, 69 percent of survey respondents who go to musical performances rated their brain health as ‘excellent’ or ‘very good’. This compared with 58 percent for those who had been in the past and 52 percent for those who never attended.
- Additionally, 68 percent of respondents who reported often being exposed to music as a child rated their ability to learn new things as ‘excellent’ or ‘very good’, compared to 50 percent of those who were not exposed to music.



- Adults without exposure to music early in life, but who currently engage in some music appreciation, scored above average for mental wellbeing.
- Active engagement with music, including people over 50, was associated with higher rates of happiness and good cognitive function.

It’s suggested that because music activates so many brain regions and networks, it keeps the connections between those neurons connected (Hebb’s Law). This includes the networks involved in wellbeing, learning, cognitive function, quality of life, and happiness. Although the results are very positive about music and did involve over three thousand responses, it’s worth noting that it was only a survey of people’s opinion rather than an objective measurement using an MRI scanner, for example. And the results are only correlations rather than proof. Other factors may have been at work when the youngsters were being exposed to music as children.

According to neuroscientist Kiminobu Sugaya, music can:

- Change your ability to perceive time
- Tap into primal fears
- Reduce seizures
- Make you a better communicator
- Make you stronger
- Boost your immune system
- Assist in repairing brain damage
- Make you smarter
- Evoke memories
- Help Parkinson’s patients.

There’s also evidence suggesting that music can decrease seizure frequency, stop refractory status epilepticus, and decrease electroencephalographic spike frequency in children with epilepsy. Research also shows that listening to music can reduce anxiety, blood pressure, and pain as well as improve sleep quality, mood, mental alertness, and memory. It can also help keep off the effects of ageing. For example, giving 13 older adults piano lessons improved their attention, memory, problem-solving abilities, mood, and quality of life.

People often listen to the same songs and genre of music as they did in their teens and 20s. It's suggested that new music challenges the brain, which has a positive effect on the brain.

Interestingly, Berthold-Losleben *et al* (2021) wrote in BMC Journal about the effects of a short-term musical training on implicit emotion regulation. They investigated whether, in a controlled environment, music could change people's emotional responses to unpleasant smells. They found that listening to music twice a day for three weeks can reduce negative emotions elicited by a bad odour, particularly if one hears music again. So, basically, music could improve wellbeing and help people to regulate negative emotions elicited by an external stimulus.

Why do we like music?

I guess the big question is "why does music play such a big part in human life, compared to, say the great apes?" One suggestion is that the evolution of humans involved the growth of groups of people, and this required some form of communication. It's been suggested by Susanne Langer (1951) in her book *Philosophy in a New Key* that music provided a way to communicate emotions and feelings when there weren't the words available. Music allowed connotational communication (feelings) before the denotational (a fixed literal meaning) language of words was available. That's why brains are still wired for music.

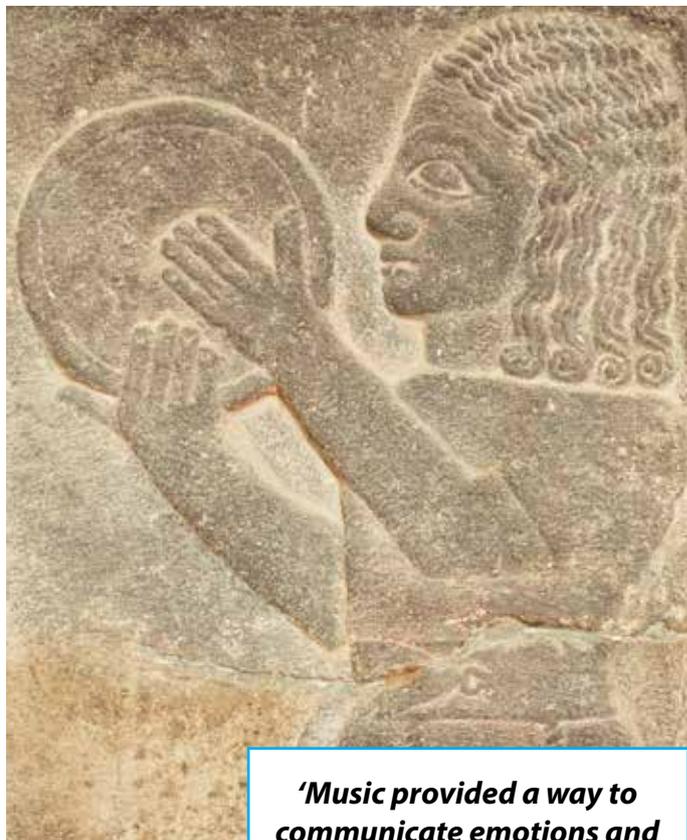
Interestingly, the sound frequencies used by parents to sing to babies and motherese (child-directed speech), with its exaggerated intonation and rhythm, are very similar to those traditionally used by composers in their melodies.

Finale

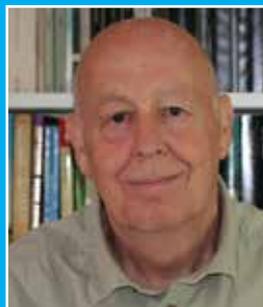
It seems that the human brain is wired for music. And the auditory cortex connects to many other parts of the brain. So, when we hear music, we can remember events from the past and feel emotions. It also seems that listening to music stimulates our brains in a very positive way making us happier, more alert, and generally feeling better. In addition, it seems humans have been responsive to music since the earliest times in their evolution. There's no doubt that listening to music is a positive activity ... and something we and our clients will benefit from.

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