Essay: 'The Mozart Effect': Can classical music improve your academic ability?

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My Extended Project Qualification topic choice is the 'Mozart Effect'. I have decided to focus on the effects of classical music, especially Wolfgang Amadeus Mozart's Sonata for Two Pianos in D Major Key K.448, and its effects on cognitive ability and spatial reasoning. As well as this, I will be looking into the original 1991 and 1993 study of 'Music and Spatial Task Performance: A Casual Relationship' by Frances H. Rauscher, Gordon L. Shaw, Linda J. Levine and Katherine N. Ky from the University of California, Irvine at the Irvine Conservatory of Music.

What is the Mozart Effect?

The 'Mozart Effect' is a theory suggesting that listening to Mozart's music will temporarily improve cognitive ability and spatial reasoning within the minds of children and adults alike. The study was originally carried out in 1991 by Frances H. Rauscher, Gordon L. Shaw, Linda J. Levine, and Katherine N. Ky at the University of California, Irvine on 36 university students. The 'Mozart Effect' study was carried out because Leng, Shaw and Wright were inspired by a model of the brain's neuronal cortex to test the hypothesis that music and spatial task performance were 'causally' related.

The lead researcher Dr Gordon Shaw began looking into the brain's capacity for spatial reasoning 1973 (The Associated Press) and then in the 1990's he went on to develop the theory that listening to classical music could improve academic abilities, commonly known as the 'Mozart Effect'.

Why The 'Mozart Effect'?

Inspiration for looking more into this theory came from a structured model of the brain's cortex that inferred that music and cognitive ability share a natural firing pattern that are organised in a similar way through a structured spatial-temporal code. This suggestion sparked a belief that the correlation between music and spatial/cognitive abilities is due to cultivation of pattern development by groups of neurons brought about by musical operations. The original study was "intended to determine if the neural firing patterns relevant to musical understanding were also relevant to spatial-temporal reasoning" (Rauscher, 2018)

Dr Gordon Shaw started to develop the theory surrounding the Mozart Effect in the early 1970's when he came interested in brain theory and the brain's capacity for spatial reasoning. Shaw and one of his graduate student Xiaodan Leng developed a model of the brain that used musical notes to show brain activity, when the notes were played back they found it to sound a lot like classical music.

However Dr Gordon Shaw was not the only person captivated by this idea. A French man by the name of Alfred A. Tomatis also looked into the co-dependence of music in the brain and published a book in 1991 called 'Pourquoi Mozart? (Why Mozart?) Yet Tomatis focused more on how Mozart's music can retrain the ear at different frequencies, having a positive effect on the ear, healing and development of the brain.

Special reasoning and cognitive ability

The 'Mozart Effect' forms its basis on the idea that Mozart's piano sonata has been known to improve the mental overcoming of cognitive dissonance and improve spatial reasoning, for a ten to fifteen minute time span. In the long run, they believed that if music is studied and appreciated from a young age (as a child's cortex is still developing at this point), that it can help develop cognitive and musical functions to a greater degree.

'Cognitive' in its purest sense is the process of performing mental tasks such as problem solving, therefore 'Cognitive Dissonance' is the action of finding new information that contradicts known beliefs causing mental conflict; for example, "when a fox sees high-hanging grapes, its desire to eat grapes and inability to reach them are in conflict. The fox overcomes this cognitive dissonance by deciding that the grapes are sour and not worth eating" (Masataka and Perlovsky, 2012). Cognitive dissonance affects specific regions of the brain such as the insula (the processor of emotions) causing it to become more active when feelings of upset or anger are felt, and the dorsolateral prefrontal cortex, which is strongly involved with cognitive control.
'Spatial Reasoning' is a factor within the reasoning skills, and it refers to the ability to think about three-dimensional objects with little information about them and from this they are able to draw up conclusions about the objects. For example, a person with good spatial reasoning would be able to think about an object and how it would look when it is rotated. The left hemisphere (the left hand side of the brain) has a main objective of controlling and developing 'Spatial Reasoning'. The left side of the brain is where maths and

spatial calculations are carried out with correlate directly to good spatial understanding.

Mozart and Classical Music

Wolfgang Amadeus Mozart (full name, Johannes Chystostomus Wolfgangus Theophilus Mozart) is possibly the most gifted classical musician in the history of classical music. Mozart was a composer, conductor, virtuoso pianist, organist and violinist, with his music embracing concertos, opera, choral, chamber, instrumental, symphony and vocal aspects.

Mozart was born in Salzburg in 1756 to a father of an ambitious Composer and Violinist; however, his sister, Nannerl was the child prodigy of the family. At the age of 16, Mozart had soon become one of music's first "freelance" professionals despite retaining the status of a chef in the Court of Salzburg.

Mozart arrived in Vienna in 1781, when he was 25, and married Constanze Weber a year later in 1782. During this time he began to put on concerts, publish music and receive commission for his operas. From 1781 to 1791, Mozart wrote around 200+ works and consolidated his reputation, yet he still had to teach piano lessons in his free time as well as taking in borders and borrowing money to maintain the lavish lifestyle he had gained from his high musical status.

Mozart composed his Sonata for Two Pianos in D major, k. 488, in 1781 when he was 25. It has three movements and is written in a sonata-allegro form with a "Galant" style that contains interlocking melodies and simultaneous cadences. It was composed for his friend Josepha Auernhammer for a performance they would give together, making it one of Mozart's few compositions written for two pianos.

Mozart is said to have died on the 5th of December 1791 at the young age of 35, however it is undetermined what he died from. There are speculations of murder by his friend Antonio Salieri by poison, yet ever-present signs of illness throughout Mozart's life dismissed this theory. The Parish register, a book recording christenings, marriages, and burials at a parish church, states he dies from a severe case of "military fever".

Mozart was known to have been an ill child and to have suffered from boughs of illness as he was growing up; from the age of nine years old he experienced the life threatening illness, possibly known as typhoid fever, as well as implications of smallpox, tonsillitis, bronchitis, pneumonia, rheumatism and gum disease. Mozart's horrific immune system leads us to the question that if Mozart's music is supposed to heal and improve the mind and body, why did he suffer from such intense illnesses throughout his lifetime.

The Original Study

The Original 'Mozart Effect' study was performed and carried out by three researches, Frances Rauscher, Katherine Ky and Dr Gordon Shaw in 1993. The study was based on thirty-six undergraduate students from the psychology department at the University of California, Irvine.

The students showed an average score increase of eight to nine points on the Stanford-Binet Intelligence Scale after listening to 10 minutes of Mozart's Sonata for Two Pianos in D Major K.448 (the classical piece was suggested by Daniel Remler). According to Rauscher "The effect lasted 10 minutes, and was not found for other domains of intelligence" such as short-term memory or spatial recognition. (Rauscher 2018)

Rauscher, Ky and Shaw's original Hypothesis states "Music, which is universally appreciated from birth, can be used to develop these inherent firing patterns, along with associated behaviours which are relevant to spatial reasoning… [They] expect that studying music will provide a longer-term facilitation, particularly for very young children in whom the cortex is still maturing." This suggests that if classical music or a musical instrument is studied and appreciated from a young age, it can help to develop cognitive and musical functions to a greater extent because at a young age a child's cortex is still developing.

In the first study carried out, 36 undergraduate students were played either 10 minutes of Mozart's Piano Sonata for two Pianos in D Major K.448, 10 minutes of a taped self-hypnosis or sat in silence for 10 minutes. But in the study that was repeated a selection of 84 students initially took part.

The students were split into three ability equivalent groups based on a test of 16-paper folding and cutting items and memory based test given to them on the first day of the experiment to measure each individual's spatial reasoning. The folding and cutting paper activity and the memory test was carried out in a way in which the students would see a photo for a minute on an overhead projector, and then they were given time to work out the answer and record it down in a booklet. From these results the students were split into groups of Mozart, silence or self-hypnosis.

The study lasted for 10 to 15 minutes and each student was paid $30 over a consecutive five-day period. A total of 84 students participated however only 79 students fully completed the experiment.

Conclusion of original results

From these results, the researchers were able to come to the conclusion that music training can help improve spatial reasoning, however they believed that further research would be needed before they could confidently state that the effects would be shown with other students or other people of different ages and backgrounds.

The Stanford-Binet test

In the original 1993 study for the findings of the 'Mozart Effect', the researchers involved sorted their three music groups based on the 80 students' scores in a test known as the Stanford-Binet intelligence test that calculates the IQ of the students. They did this to ensure that the results from the groups would not be drastically different due to differing IQ levels.

The Stanford Binet Intelligence Test is the most popular and most accurate intelligence under its fifth edition (released in 2003) as of 2018. Lewis Terman who is a psychologist at Stanford University, California revised the test from the Binet-Simon scale. The Stanford-Binet intelligence test is a Cognitive ability assessment used to measure intelligence and calculate a person's IQ (Intelligence Quotient). The test measures five aspects to Cognitive ability in a verbal and nonverbal domain: Knowledge, Fluid Reasoning, Visual-Spatial Processing, Quantitative Reasoning, and working memory.

Fluid reasoning is having the ability to reason and solve problems without previous knowledge, as well as being able to analyse and identify novel problems, patterns and relationships related to problems.

Quantitative reasoning is using basic math skills to analyse and interpret quantitative information in a problem and to conclude about it.

The Stanford-Binet intelligence test development helped form a basis for modern intelligence testing. Its origins lay in France by creator Alfred Binet and was later revised and renamed in the United States by Lewis Terman in 1916. Its original use was to pick out children with learning difficulties and place them in an education system that fitted them best.

As of 2003, the Stanford-Binet test is on its fifth edition, which was published by Gale Roid who attended Harvard University.

Aspects of Music

Within classical music, there are many elements that are involved to create the perfect piece of music. It is believed that these elements involved can change a piece of music if one differs slightly. These elements include pitch, harmony and rhythm that can alter the mood of the piece, evoking different emotions within the mind.

Shaw, Ky, Leng, Rauscher and Levine determined from a follow up study conducted that "minimalist or rhythmically repetitive musical structures do not enhance spatial task performance" and that their results showed that "a particular organisation of musical elements is necessary for improvement in spatial task performance". The groups listening to repetitive music like the third group that listened to Philip Glass and British trance music experienced no effect reinforcing the belief that more complexly structured music can improve spatial-temporal tasks.

For a sound to be produced a vibration needs to be sent up into the air. Regular vibrations produce a note of a certain pitch that can be identified easily. The faster the vibration, the higher the pitch of the note and the longer the column of air that is created and the slower the vibration, the lower the pitch. For a human the hearing threshold we possess is from around 16-20 vibrations per second to around 20,000 vibrations per second (Burrows and Solti, 2005).

The Dynamics of a piece of classical music relates to the volume or intensity of sound, which can be varied like pitch or rhythm. This can affect and change the whole tone and mood of a piece. There is strong evidence that suggests that listening to music that produces arousal and mild happiness within a person's mind, they are more likely to perform better at certain tasks.

A piece of classical music will follow a harmony made up of chords and cadences. A 'Cadence' is a closing expression of a chord. A 'perfect cadence' or a 'plagal' sound sounds conclusive, serious and final, whereas 'imperfect cadence' sounds inconclusive and unfinished and demands continuation. However the piece of music is made up, will evoke different emotions from the listener that can form a range of emotions which is something that had to be thought out when choosing the perfect piece of music for the Mozart experiment. With Harmony, comes Tonation and Scales. "A scale is a stepwise series of notes, usually between one note and the next note of [the same] name, an octave higher" (Burrows and Solti, 2005). The 'Ionian' scale is a 'major' scale, and the 'Aeolian' scale is the 'natural minor' scale. Minor scales have connotations of positivity, joy and triumph where as minor scales have connotations of sombre, plaintive and sometimes tragic tones. Rhythm and tempo involves the positioning and spacing of the notes in time as well as the duration of the note. The beat is a regular pulse of time that is followed by the rhythm of a piece of music is organised and formed. The speed of the beat is the tempo of the piece. The tempo of a piece of classical music would also evoke certain emotions that could affect how the mind is stimulated, meaning the type of music that was chosen for the experiment would have had to actively and effectively stimulate the mind.

Brain and music

There are certain parts of the brain that are stimulated when listening to music and they are the auditory cortex, cerebrum, cerebellum and the limbic system. When choosing a piece of music there were aspects that needed to be thought about and addressed by Shaw, Rauscher, Ky, Leng and Levine. Some of the aspects that needed to be considered were the volume of the piece of music, the material they were subjecting to the students, the tempo of the music, if the students had a musical background and the gender ratio of the students.

Within the brains of musicians, they happen to have an enhanced synaptic plasticity, which is an increase in the creation of new neural pathways as well as this there is a higher chance synapses strengthen/weaken in response to stimulation. However playing a musical instrument and/or listening to music has the possibility to reduce neural plasticity through old age in areas like verbal memory (Lapham, 2016).

The ability to work well is not solely placed on musical affects/stimulation within the brain; it is also focused on mood and feelings possessed by the human mind. Our emotional state can alter our ability as we allow music to influence our feelings and emotions (Lapham, 2016). The feelings provoked by music will help involve cognitive and spatial-temporal reasoning based on the enjoyment and engagement the listener feels because of the music (Hammond, 2013).

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Media exposure

The 'Mozart Effect' was coined in 1991 by the Boston Globe in reference to the belief that classical music makes you "smarter". However when asking a range of people if they knew what the 'Mozart Effect' was, I received differing answers that ranged from listening to classical music in the womb making you smarter to

Mozart's classical pieces being able to "alleviate AIDS, allergies, and Diabetes" (Swartz, Campbell 1997,226-252).

The media's over exposure and dissolution of the original findings by Rauscher, Ky and Shaw have changed their findings to create a whole new theory and in that, forming an empire of ill-informed people.

Many of the answers I was presented with were focused on the idea that classical music makes you smarter, playing classical music to a baby in the womb helps them grow up to be more intelligent, or that having children play a musical instrument from a younger age makes them achieve higher academically. From the original study that was focused on earlier, these suggestions fail to align with the study's findings that infer a 8-9 point increase in the IQs of California college students after listening to 10 minutes of a Mozart sonata and performing spatial reasoning activities. But why is this the case?

Not only the media, but also the public ate up the findings that were published in a 500-word 1993 Nature article. Incredibly, Mozart CDs sold out in Boston (Shaw, 2005), and the Governor of the state of Georgia, Zell Miller, was so intrigued with the results from the study that he called for $105,000 to be given for free classical music tapes to be given to every new mother in the State (Hammond, 2013); it is clear that the findings caught the attention of the US press and public. The effects of this media frenzy are still apparent today in Florida, where it is required to play classical music in the background of day cares, as well as in New York where a community college has a "Mozart Effect" study room! (Swartz, Gladwell 2000).

However the results weren't just restricted by the borders of the United States, as it stands a psychologist, Sergio Della Sala visited a mozzarella farm in Italy where a farmer happily admitted to playing classical music three times a day to his buffalos to help they produce a better quality milk (Hammond, 2013).

The original researchers, especially Frances Rauscher and Gordon Shaw, support that the media's overexposure contributed to the mass misunderstanding of their findings. Rauscher believes that "it is a very giant leap to think that if music has a short term effect on college students that it will produce smarter children" (Swartz, Jones 2000). In corresponding with Rauscher myself, she agreed with the benefits the media frenzy brought about however her shock at the vast coverage and its twist on their results still remains:

"While I think it's wonderful that our findings have helped place music instruction back in the schools at the elementary school level, I am a bit dismayed that the findings from our original study…were so misunderstood" (Rauscher, 2018).

It is safe to say that the 'Mozart Effects' finding have been distorted and given a lot more credit than they are due as the press and the media have misunderstood and failed to look into the findings of the original 1993 study, leading to incorrect claims now being associated with the theory!

Criticisms

When the Mozart Effect findings were published in the Nature Journal under the name "Music and Spatial Task Performance" the media and the public took to it immediately. However as time passed and the findings spread throughout lay culture it got simplified and completely distorted to a whole new belief, that classical music can help make babies smarter.

A similar and more accepted psychological ideal that is more commonly know is called 'Priming' and it refers to the action of "warming up" brain neurons when they are stimulated by a task. An example of priming would be someone who had worked on a large number of mathematical exercises will have their neurons "primed" and will do better on that activity whereas someone going straight into mathematical equations would not do as well.

The original theory had not ever been officially studied on babies and young children contrary to what was publically believed. As well as this, it is believed that the original 1993 study had only seen a small, temporary IQ increase in the 76 California, Irvine university students on a task so specific and fairly useless within many educational purposes while listening to 10 minutes of a 7 minute Mozart sonata. In a 1999 review, a dozen other studies failed to recreate the findings of the 1993 results.

The media exaggerated the findings however there have been many attempts to replicate the findings of the 1993 experiment that were met with mixed results; some have failed to show the effect's results significantly whereas others have been able to reproduce the findings. The reasons offered for this fluctuation in replicating results comes from the 'Mozart Effect' only improving certain spatial-temporal tasks; when the results were reread it was found that the only significant involvement came from the Paper Folding and

cutting section of the study, explaining why experiments involving non-spatial-temporal task had failed.
To add to the issue of replicating the effects of the Mozart study, Dr Gordon Shaw believed to have found the first movement of the Sonata used, very important. So its must be addressed if everyone used the first movement of the sonata as most recordings of the movement are eight minutes long but the groups in the original experiment were said to have listened to ten minutes of Mozart, so there is inconsistency here.
It does not help that authors such as Don Campbell publish books relating to the Mozart Effect that have little to no reference to the study. Campbell's "The Mozart Effect: Tapping the Power of Music to Heal the Body, Strengthen the Mind, and Unlock the Creative Spirit" is a good example of this; when reading this book I found that Campbell only addresses the 1993 study for two and a half pages despite the study's coined name being in the main title of the novel.

Other studies
An earlier experiment of music and its effects on the brain was conducted in 1988 by neurobiologist Dr Gordon Shaw and a graduate student, Xiaodan Leng. They attempted to create brain activity on a computer in the University of California, Irvine.
Shaw and Leng hypothesised that "if brain activity can sound like music, might it be possible to begin to understand the neural activity by working in reverse and observing how the brain responds to music? Might patterns in music somehow stimulate the brain by activating similar firing patterns of nerve dusters?"
They found that their attempts simulated the way nerve cells were connected to one another and that predisposed groups of cells adopted certain specific firing patterns and rhythms. Dr Gordon Shaw summarises that "these patterns form the basic exchange of mental activity". With this information they chose to turn the output of their simulation into sounds instead of a print out, and to their surprise the rhythmic pattern sounded familiar to that of the characteristics of new eastern music.
Essentially this earlier experiment carried out by Gordon Shaw and Xiaodan Leng paved the way towards the Mozart effect as it formed the original belief that if activity carried out by the brain sounded like music then maybe music can improve or enhance the way the brain responds, as they seem to be interlinked.
My study
I decided that to come to my own conclusion about the results and effects of the 'Mozart Effect', I would need to carry out a study of my own in the Easter half term holiday. I was able to gather six friends and family to take part in this study, all of varying ages (16-64) in my local youth centre. I had originally wanted more people to take part in this study but found it easier to carry the study out on a smaller number of people who were readily available to me.
I had the same hypothesis as the researchers did in the original experiment, to see if 10 minutes of Mozart will help improve cognitive and spatial-temporal reasoning. However I had to perform the study on a smaller scale, so instead of carrying it out on 36 college students it was 6 friends and family, also I did not carry the study out over five days, but two hours with half an hour breaks between tasks as I did not physically have the time or the resources to commit to replicating the original study, step by step.
However like the original and follow up studies by Rauscher, Levine, Leng, Ky and Shaw, all members involved in the study were split into three groups based on the scores of a memory test. Group one was sat in silence for the four activities, group two listened to ten minutes of Mozart's Sonata in D Major K.488 (the piece was repeated as it was 8 minutes long), and the final group listened to a medley of Philip Glass in the first exercise, The Chief by Melissa Banks in the second, "British-Style dance music (trance)" I found online in the third, and then one person from group three joined group two and the other joined group one.
Conclusion of Results

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