The Mozart Effect in the Classroom.

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Abstract

This paper looks at the Mozart Effect and examines the studies that have challenged the original premise of Rauscher (1993). Research indicates that listening to music, and background music, can impact on academic performance; however this effect is due to the fact that music can induce arousal and mood changes which, in turn, stimulate learning, rather than to any specific characteristics of Mozart's music. The impact that music can have in learning situations is examined based on evidence from music psychology. Suggestions are made as to how and what kind of music might be used in different classroom situations to create particular and more effective learning environments. Proposals and recommendations are made for future research in this area.

Introduction

The advertising industry has been responsible for much research into the effect of background music on a wide range of diverse activities, from driving to gambling to eating at a restaurant. Background music has been shown to affect the in-store behaviour of consumers; shoppers move at a slower pace through stores when slow music is played, and spend more money than when the background music is fast (Garlin and Owen, 2005). Pleasant background music in restaurants is associated with more time spent over a meal, and more time in the restaurant influences the amount of money spent (Hibbert, 2002). Music is widely used as an emotional stimulus in advertising to stimulate purchase motivation (Morris & Boone, 1998). The fact that music affects mood and behaviour is well documented (Clynes, 1983; Hallam, 2006; Hargreaves, 1997), and specific aspects of music contribute to a greater or lesser extent to this behaviour. Not all of this is positive. It is suggested that music has the potential to be important in the acquisition, development and maintenance of gambling behaviour (Griffiths *et al,* 2005). Furthermore, tests have indicated that certain types of music can have a negative effect on motor driving behaviour; music tempo affects driving speed and perceived speed estimates (Brodsky, 2001). Since music has an impact in so many diverse areas, it is highly possible that it could impact on the learning environment.

Until relatively recently, little research had been done on the impact of music on learning. Proponents of music in the curriculum have, however, since the early 1900s, proclaimed that participation in band, choir and orchestra has a positive effect in a variety of disparate areas including academic achievement, self-discipline, citizenship - even personal hygiene! (Morrison, 1994, 33). A number of factors have generated interest in the study of the association between exposure to music, music education and academic achievement. Many music educators and policy makers have sought to affirm the idea that participation in the arts can have a positive effect on academic achievement. Furthermore, the dissemination in the public press of the idea that listening to the music of Mozart could improve performance in academic tests (Rauscher *et al,* 1993), sparked

wide-spread debate in academic circles. This hypothesis became widely known as the 'Mozart Effect'.

The idea that there could be a link between music and intelligence is not new. In particular, the notion that there is a link between mathematics and music is a widely held belief. Many musicologists point out links between structures in music and mathematics, and studies have been made of numerology in music. Igor Stravinsky stated that music is 'something like mathematical thinking and mathematical relationships' (Vaughn, 2000: 149). In his book, *Musimatics,* Loy describes the two subjects as 'twins' (2006: xv). He states that 'mathematics can be as effortless as humming a tune, if you know the tune' (*ibid*).

The controversy that followed Raucher's study was largely due to the diffusion of this idea outside of the scientific sphere, and into the general media where it was often misrepresented (Bangerter and Heath, 2004). The idea that listening to music could raise children's IQ led to head-lines such as ' Music Makes you Child Brainier'; politicians, educators and policy-makers promoted the idea of playing music for infants, and the governor of Georgia, Zell Millar, distributed CDs of classical music to all infants born in the state (Hetland, 2000). The concept was taken up by music educators to advocate for music programmes in schools, and the idea that music education impacted in other academic areas was used as a rationale for its inclusion in school curricula.

The article by Rauscher *et al* (1993) spawned many studies which sought to examine the link between exposure to music and general academic achievement. The studies can be divided into two broad categories: the impact of passive listening to music on performance in academic tests and the impact of music instruction on academic achievement (Schellenberg, 2001). Researchers have examined for links between music and general intelligence, reading, mathematics, and spatial reasoning. There is a considerable body of evidence that associates academic achievement with participation in music education, although the reason for this link is open to debate. The focus of this paper will, however, be on the effect of passive listening to music on academic

performance, in particular in the light of Raucher's claims. I will consider the evidence relating to the Mozart Effect hypothesis and suggest ways, based on this evidence, of how passive listening to music might enhance classroom performance and learning.

The Mozart Effect

The term 'Mozart Effect', (ME) was originally associated with the temporary enhancement of spatial-temporal reasoning abilities immediately after listening to a piece of music by Mozart (Ivanov and Geate, 2003). However, through a process of conflation, and frequently, misrepresentation, it has become more widely used to represent links between listening to music and performance in any type of academic test. Having found correlational, historical and anecdotal evidence for relationships between music cognition and other higher brain functions, Rauscher *et al* (1993) set out to demonstrate a link between music cognition and cognitions pertaining to abstract operations such as mathematical or spatial reasoning. The subjects of the initial 1993 study were 36 college students who were given three sets of standard IQ spatial reasoning tasks from the Stanford-Binet intelligence scale following three different conditions: these were 10 minutes of (1) listening to Mozart's *Sonata for Two Pianos in D Major, K448*; (2) listening to a relaxation tape; or (3) silence. To assess the impact of the scores, the test results were 'translated' to spatial IQ scores of 119, 111 and 110 respectively. Thus the subjects participating in the music condition were 8-9 points above the scores for the other two conditions. The result for the music condition differed significantly from the relaxation tape and the silence conditions, while the relaxation and silence conditions did not differ widely. The enhancing effect did not last past 10-15 minutes of the listening condition.

A further study, by Rauscher *et al* (1995), attempts to find a causal relationship for this result. The authors have hypothesised that the possible link between listening to the music of Mozart and improved performance in spatial-reasoning tasks is due to the 'trion' model of the cortex. This would involve columns of neurons in the cortex which are used in musical processing "priming" the neurons used for spatial tasks (Hetland, 2000: 105).

Further tests clarified that the ME relates only to certain spatial tasks, namely temporal-spatial and spatial imagery. They also state that it was not only specific to the music of Mozart, but to any music of a complex nature, which would have a greater effect than music of a repetitive nature (Rauscher *et al*., 1998).

A number of studies have sought to examine the efficacy of the ME, and to examine variables which may account for the positive results of Rauscher's findings. These produced mixed results, with many finding small or insignificant correlations between listening to Mozart and improved performance in academic tasks. A study by Hallam (2000), involving over 8,000 children aged 10-11 across 150 UK primary schools, concluded that previous positive results can be explained by differences in pre-test arousal. Chabris (1999) found that compared to silence, music enhanced cognitive task performance to a trivial degree. He found greater effects on tasks when music was compared to relaxation. He therefore concluded that this effect was due to arousal. Hetland (2000) did find evidence for a ME; she concluded that it is a modest but robust effect, and is limited to a specific type of spatial task (spatial-temporal) thus supporting Rauscher's findings in the original sense of the ME. Hetland found that the effect is not limited to the music of Mozart, although it is not clear from the study what type of music causes this effect.

Many further hypotheses have been advanced to explain the ME. One is that it can be explained by particular elements of music; rhythm, timbre, melody, dynamics etc. Parsons (1999) found improved performance after auditory and visual *rhythmic* stimuli – as opposed to silence, a continuous tone and melody without rhythm. Furthermore, the repetitive music of Philip Glass produced no enhancement in task performance while the more rhythmically stimulating music of Mozart's K448 did.

The underlying assumption for the positive effects of the ME is that it is a psychological effect like that of transfer or priming (Nantais and Schellenberg, 1999). Transfer is said to occur when knowledge or skill acquired in one situation influences performance in another (Nantais and Schellenberg, 1999, after Postman, 1971). Nantais and

Schellenberg challenge this notion, stating that no learning takes place in the ME because it merely involves passive listening (1999). They question whether priming or transfer could possibly take place when it is far from obvious which features are shared by listening to music and spatial-temporal reasoning. In a later paper, Schellenberg (2001) points out that in studies where a significant effect for the ME was found, the comparative conditions of the control group were less stimulating than the music condition – i.e. repetitive music, silence or relaxation tapes. He infers that the minimalist and repetitive music of Philip Glass and silence may have induced boredom in the students, therefore leading to poorer performance in the tests.

Nantais and Schellenberg (1999) set out to examine preference as a factor in increasing arousal, therefore having a positive or negative effect on results. The auditory stimuli used were Schubert's *Fantasia for Piano in F minor, (D.940)*, Mozart's (K448) and silence. Their results indicated that students scored significantly better after the music stimulus, but there was no significant difference between the Mozart and Schubert stimulus. The authors therefore concluded that the ME had nothing to do with the music of Mozart *per se* but could generalize to any enjoyable music of the Classical period, *or* even to any positive stimulus. A second experiment supported this latter hypothesis because when the silence condition was substituted by a story there was no significant difference in test scores. However, when the indicated preference of the student (between the music and story stimulus) was taken into account, scores were significantly higher in the preferred condition than the non-preferred condition. They propose therefore that task performance may be improved by listening to any pleasant auditory stimulus. Conversely, performance may be negatively affected by boring or unpleasant stimuli. They therefore concluded that the ME was an artefact of preference.

Schellenberg cites a number of studies which have shown that arousal can affect performance in cognitive and problem solving tasks; extreme high or low levels of arousal can inhibit performance, whereas moderate levels can enhance performance (Berlyne, 1997; Sarason, 1980), with boredom and negative moods having a detrimental effect on performance (Keoster & Farley, 1982). Having concluded that 'alteration to the

control condition (i.e. listening to a narrated story instead of sitting in silence) eliminated the Mozart Effect' (Nantais and Schellenberg, 1999), Hussain, Thomson, Schellenberg (2001) set out to examine the contribution of arousal and mood to the ME. In this study 24 college students (graduates and under-graduates) listened to 10 minutes of Mozart's K448 and 10 minutes of Albinoni's *Adagio in G Minor for Organ and Strings.*

The results indicated that performance on a spatial task was significantly better after participants listened to Mozart than for the silence condition; however there was no effect of condition (between music and silence) for the Albinoni group. In the music condition scores on the Profile of Mood States (POMS) (McNair, Lorr & Droppleman, 1992) arousal scale were significantly higher for the Mozart group than for the Albinoni group, who also scored significantly lower in the POMS mood scale; enjoyment scores were also higher for the Mozart group. Participants scored better after listening to Mozart than sitting in silence; however, there was no difference between listening to Albinoni (slow or sad music) and silence. This led the authors to conclude that different levels of arousal, mood and enjoyment closely parallel performance differences on the academic tasks, and that the ME is associated with positive rather than negative mood. The authors point out that positive mood and arousal are not the same. They conclude that: 'the Mozart effect can be explained simply: enjoyable stimuli induce positive affect and heightened levels of arousal, which lead to modest improvements in performance on a variety of tasks' (Hussain, Thomson, Schellenberg, 2001: 251).

A further study by these authors involved a Mozart Sonata being recorded in four modes – a fast and slow tempo and major and minor (happy and sad) modes. Performance in spatial tasks was better after the music with a fast tempo, and the major rather than minor mode (Husain, Thomson and Schellenberg, 2002). They found that tempo manipulations affected arousal and not mood, while mode (major and minor) affected mood and not arousal.

Discussion

Schellenberg states 'we now know that such enhancement [the ME] is a consequence of the listener's arousal level and mood' (2006: 457). So while the original premise of

Rauscher's ME cannot be upheld, the evidence would indicate that music has an impact on academic performance at certain levels and, as in other areas of behaviour, could be used to positive effect in learning situations. Several studies have shown that music can improve the behaviour and academic performance of children with emotional and behavioural difficulties (Savan, 1996; Hallam and Price, 1998). We have also seen from the studies cited that certain musical styles can have a greater impact than others.
Much of the early work done on music and mood was carried out by Hevner (1936) and this work remains very influential today. She reported associations between musical elements, such as fast tempo, loud dynamics, rhythm and register with perceptions of music as happy, merry, graceful etc. Slow, quiet, low register music were reported as sad, dreamy or sentimental (Alpert, M et al 2005).

Lehmann *et al* cite a study by Schubert (2003) which develops a model of adjective clusters, which are schematically aligned around a circle, which has as its axes, valance (positive and negative reactions to music) and activity (high and low stimulation from music). Music that has positive effect and high stimulation level is described as 'bright, cheerful, happy, joyous' or 'humorous, light, lyrical, merry, playful' (Lehmann *et al*, 2007: 218). On the other hand music that provokes negative valance and low activity is 'dark, depressing, gloomy, melancholy, mournful, sad, solemn' or 'tragic, yearning' (*ibid*). Certain music can, according to Schubert's scheme, have high activity but low valance; this would be described as 'agitated, angry, restless, tense' (*ibid*). On the other hand, certain types of music can have a high valance but low activity; this would be described as 'calm delicate, graceful, quiet, relaxed, serene, soothing...' (*ibid*). In choosing music for the classroom environment, these parameters may offer a guide. While it is unlikely that one would require music with negative valance, a situation may arise (e.g. for a noisy and disruptive class) where high valance but low activity is required.

In the following paragraphs suggestions will be made for certain uses for music in the classroom environment, and suggest music that might be used – based on the studies cited above and personal experience. The author would hasten to add that these

suggestions are based on experiential rather than scientific observation, but suggest that they may be useful in different classroom environments to create certain desired affects. Because the music used in the original test which sparked the ME debate (Raucher, 1993), was Mozart's *Sonata for Two Pianos in D Major, K 448*, several of the studies examining the ME have used this work. This is a fast rhythmic piece, with a steady strong pulse throughout; the tempo indication is '*allegro con spirito'* (approximately □ = 144. Similarly the Schubert *Fantasia for Piano in F minor, (D.940)* mentioned above (Nantais and Schellenberg, 1999) is also for four hands – though for only one piano in this case; the tempo here is indicated '*allegro molto moderato',* (approximately □ = 88), and is therefore not as fast as the Mozart. The Albinoni *Adagio in G minor* is for strings and by contrast is very slow (approximately □ = 36). All of these could be classed as chamber music, with the duet element on the piano giving a somewhat richer texture than a solo piano. In choosing excerpts for the classroom, chamber music or small orchestral works might be more appropriate, with large scale orchestral works being a bit overwhelming. Pieces such as Wagner's *Ride of the Valkyries,* or the 4th and 5th movements of Berlioz's *Symphonie Fantastique* would have a high arousal factor and high and low valance respectively, but their dramatic nature might be confrontational and unsettling.

Music played at the beginning of a lecture or class can have a number of functions. It should create a positive mood as students come into the class; as the students will be moderately aroused at this point, it need not be overly stimulating. Furthermore, the students need to settle and focus, and the end of the music (in overture fashion) can indicate that the lecture is about to begin and calls for attention. We have already indicated that moderate arousal and positive mood enhances academic performance. Farnsworth (1969) found a strong correlation between major and minor modes and happy and sad moods, and the faster music of Mozart and Schubert has been found to be more stimulating than that of the beautiful but extremely slow *Adagio in G minor* of Albinoni. It has also been suggested that the music should be moderately complex, and I would recommend that overly familiar music (such as pop songs) should be avoided as it will just seem like the ubiquitous piped music we have become immune to. There are several choices that could fulfil these criteria, one suggestion being *Vltava* by Smetana. This

piece moves from a gentle minor introduction to an uplifting major coda with many episodes in between. Because it lasts more than 10 minutes, it may be suitable where there is a lot of setting up to do at the outset. Several *allegro* movements from Vivaldi concerti, the Bach *Brandenburg* concerti or Handel's orchestral suites would also be appropriate here. Lehmann *et al* state that unfamiliarity and over-familiarity does not arouse in a positive way but creates overstimulation or boredom (2007, 219). The audience therefore should be taken into account. For example Vivaldi's *Four Seasons* might be overly familiar to a more mature audience, so a similar style piece – a less well-known Vivaldi concerto - might be more appropriate here; on the other hand a young group who are not as accustomed to hearing this type of music may prefer to hear a movement that they recognise but is not overly familiar. Several string quartet movements would also be appropriate here with choices depending on the intensity required: Smetana's *String Quartet No. 1 in E Minor* (2nd movement, *allegro moderato*) (high intensity) or Boccherini's *Minuetto* from *String Quintet in E major, op. 11, No. 5* (low intensity).

Where students move from one class to another without a break or where they have long sessions (as in many evening classes), music can be used to arouse or energise during a break or interval. Lehmann *et al* state that 'listening to music elicits a reaction to the one we have when eating chocolate or making love' (2007, 221). In the event that students are given a break during a long session, listening to music may be a healthier option than either of the aforementioned! Many of the previously cited studies have used deliberate auditory stimuli where the subjects listen attentively. In the case of an interval during a long session the student cannot be required to sit and listen attentively, but would need to be encouraged to do so. To solve this problem, the cue was taken from Haydn. When composing his *Symphony No. 94 in G major,* he introduced a sudden *forte* chord during the second movement (*Andante*). It is said that this was done as a joke to wake up those who had begun to drift off to sleep during the performance. This symphony therefore became known as The Surprise Symphony. When endeavouring to engage the students with background music, attempts should be made to try to introduce an element of surprise in the chosen excerpts. Micheal Ō Suilleabháin's *Idir Eatarthu* (Between

Worlds) is ideal for this. As the title indicates, it moves from one 'world' to another, beginning in a classical vein and changing suddenly and dramatically to a traditional tune. The dramatic, percussive change usually elicits a response from students even when they are engaged in conversation.

While the author does not often use vocal music, it has been found that the Pavarotti and Friends series of recordings also provoke a similar reaction. The contrast between the quite familiar timbre of Eric Clapton's voice, modulating (literally) to the hugely rich timbre of Pavarotti's voice always invokes a reaction. Imagine other unlikely juxtapositions such as Pavarotti with Deep Purple or Sting and the 'surprise' element is evident. The students engage with the music, listening more attentively and are not impervious to it as they might be with much background music.

Music that is slightly quirky or whimsical can also be useful to get attention. Pontinen's Improvisations on Rota's theme for the film Amarcord provide such an atmosphere with a blues feel but with some surprising and dramatic flourishes. Keeping in the blues vein, but demanding more from the listener would be the Three Preludes for Piano by Gershwin, and Ravel's Blues from Violin Sonata in G major.

A further advantage to playing music that is perceived as pleasant during the interval is that listening to 'liked' music is associated with longer time perception (Kellaris and Kent, 1992); listening to liked music therefore may alter the students' perception of time and the break would appear longer, rather than silence or music that is perceived as less pleasant.

Conclusion

Despite the fact that the original premise of the ME cannot be verified, there is considerable evidence that background music can impact on the learning environment – although this is an artefact of arousal, mood and preference. The use of music in the classroom should not be arbitrary, or it will have little more effect than piped music and may be ignored. Judicious choices should be made based on the audience and the

required mood or atmosphere. Certain musical excerpts can be used to create a calm environment, others for arousal or stimulation, but all should be pleasant to create positive associations with the learning experience. The suggestions here are based on personal rather than scientific experience, but they do take into account the available research into music psychology.

Interesting questions arise, however, such as whether particular types of music may be more effective for particular learning objectives or for different disciplines. Would different styles of music be more suitable for mathematically or technically based subjects as opposed to creative design or artistic environments? The scope of this paper did not allow for a discussion on the impact of background music while the students work. It would be interesting to examine how background music impacts on the work rate and creativity of fashion design students during their practical sessions. What would the impact be of background music on science students working in a laboratory, or architectural students during technical drawing sessions? Would different types of music be more appropriate for creative or analytical situations? It could be surmised that music from the Baroque and Classical periods might be more appropriate for analytical subjects, while music from the Romantic period would be better suited to creative situations. As yet, there is no evidence to support such a hypothesis, but they remain interesting research questions for further study.

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