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The Effect of Background Music on Task Performance

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Huron College

Jones and Estell (2006) conducted two studies based on the preliminary findings of the Mozart effect. They first hypothesized that the participants’ at the college age level would temporarily increase spatial ability on an test from the Stanford Binet Intelligence Scale, while listening to Mozart music, compared to students placed in the silence condition. The results from this study were significant in finding that the students’ spatial ability did improve temporarily after exposure to 15 minutes of Mozart music. Twenty subjects were equally divided based on sex into either the Mozart Music group, or the popular culture music group. Participants were required to listen to the music from the group they were randomly placed in, while completing the Stoop Task. Analyses were computed using a 2x2 between-subjects ANOVA design and a post-hoc independent samples t-test.

A large industry has evolved from research stemming from the Mozart effect; with a strong manifesto that listening to Mozart will enhance intelligence. Companies have created books, Cds, and videotapes, which offer parents the belief that immersing their children into this lifestyle will enhance their intellectual functioning. The Mozart effect claims that music temporarily enhances spatial ability. Music plays a role among higher brain functions, as it is universally accepted, beginning at birth. Music has been said to be a “pre language” in infants, because of areas allocated to music in the brain, which differ from language centers in the cortex, available at an early age. This area in the brain can access the firing patterns from music, and enhance the cortex’s ability to achieve pattern development and as result, improve higher brain functions (Rauscher, Shaw & Ky, 1995). Early Mozart investigators believed that listening to Mozart for a
short period of time, primes the same neurological pathways used for spatial tasks, and enhances performance by optimizing arousal, or mood for taking a test. Biological evidence has shown that early music training can enhance long-term cognitive abilities.

Jones & Estell (2006) conducted a study to distinguish which aspects of previous research are evident in music paired with spatial ability tasks. The study examined whether listening to Mozart, arousal or preference most affects spatial performance. The participants were randomly assigned to either experimental Mozart condition or control silence condition groups. Upon completion of the 7.5-minute trial, the students were asked to self-report their arousal and preference based on the condition they were assigned to. Following that, they were given a spatial ability task, derived from the Stanford-Binet Intelligence Scales. The study demonstrated that 41 college students, both male and female, enhanced their spatial performance after listening to Mozart, confirming the Mozart effect findings. The results also suggest that arousal was a significant covariate, and played a role between the silence and Mozart condition groups. The overall finding from the study validates the claim, that passively listening to Mozart might prime key neurological pathways prior to completing a spatial ability task.

In contrast to the neurological argument, the arousal argument challenges that listening to Mozart heightens or optimizes emotional levels, which results in higher performance on intelligence tests (Steele, Bass & Crook, as cited in Jones & Estell, 2007). This claim suggests that listening to Mozart either heightens insufficient arousal or lessens excessive arousal levels before engaging in spatial testing (Jones & Estell, 2007). Jones and Estell replicated their previous study, to answer the question, if the
Mozart effect exists in the unstudied population of high school students. The researchers aimed to examine what mechanism caused the relationship between listening to Mozart and spatial intelligence performance. The study was conducted with a sample of 86 high school students, who completed the same procedure and measures as in the previous study of college students. The findings from the data collected showed that there was no difference between male and female student’s spatial performance. The spatial intelligence scores were highest from the Mozart group, which suggests that this type of music improved spatial performance. The results for the interaction between exposure to silence or Mozart and the arousal levels, on spatial performance, propose a relationship between arousal level and exposure to Mozart or silence. The students in the silence groups who self reported as having no shift in arousal, performed better than other students in the same group but who reported themselves as more awake or less awake. The final results from the study give evidence towards the theory that listening to Mozart relates to performance on spatial ability tasks, but does not increase arousal in high school students.

Cassidy and Macdonald (2007), claim that to understand the effects of music on an individual, the researcher must take into consideration the interaction between the listener, the music and the context in which the task is taking place (Miell, MacDonald and Hargreaves, 2005 as cited in Cassidy & Macdonald, 2007). Music is categorized into groups in terms of how much stimulation the song offers. It has been observed that ‘low information load’ music has improved results on reading comprehension tasks. In contrast, ‘high information load’ music negatively affected performance on the same type of task, as well as popular instrumental music. Furnham and Bradley (1997) as
cited in Cassidy and Macdonald (2007), examined performance on immediate and
delayed recall memory tasks and reading comprehension in the presence of background
vocal ‘pop music’, reporting negative effects of music on the immediate and delayed
recall tasks. Music can have a positive effect as it can act as a stress reliever while
performing everyday tasks, but can be distracting and cause negative effects on complex
mental tasks. Task related factors may influence cognitive processing, and emphasize
the positive and negative effects of different forms of music (Cassidy & Macdonald,
2007). A pre study session was conducted with forty participants who ranged in age
from 14-50, and rated 40 ‘popular’ music pieces, to generate musical stimuli for the
main experiment. The study included 40 undergraduate college students, who completed
the Eysenck Personality Inventory questionnaire, to determine if they were introverted
or extraverted. The participants were given 5 cognitive tasks to complete, including the
Stroop task and various recall tasks. The participants completed the five tasks in one of
four background sound conditions: positive low arousal music labeled as relaxing (LA),
negative high arousal music labeled as aggressive (NA), background noise and silence.
The results from the study show that task performance was significantly better in silence
and Low Arousal music than in the presence of noise of High Arousal music. There was
no significant difference between performance in the HA and noise conditions with both
being detrimental to performance. The findings indicate that participants who completed
the tasks in the presence of High Arousal music and noise were less able to suppress
irrelevant visual stimuli on the Stroop task, than those who completed tasks in LA music
or silence.

Schellenberg, Thompson and Hussain (2001), tested the Mozart effect in
comparison to another classical piece composed by Albinoni. The researchers
formulated the arousal and mood hypothesis stating that listening to Mozart is one example of a stimulus that can influence the perceiver’s arousal level and mood, which can affect performance on numerous cognitive tasks (Schellenberg et al., 2001). Arousal and mood were higher in this study after listening to Mozart.

The current study offers aspects from each of the theories mentioned above, for why certain types of music can affect spatial ability performance. Similar to Cassidy and Macdonald (2007), this study is examining motivation through either a high or low arousal song, to complete a spatial ability task successfully. It is predicted that the participants in the low arousal, low information load song group, who self reported as feeling more awake, will score significantly higher than the high arousal, high information load group. It can also be predicted that there will be significantly more errors and longer reading or responding times for the high arousal, high information load group on the specific incongruent word-colour cases.

Method

Participants

Twenty University and College students from the University of Western Ontario and Huron University College participated in the study. Participants were between the ages 18 and 22 and were mainly Caucasian. There were an equal number of 10 males and 10 females. The participants were randomly assigned to either a low arousal song group, or a high arousal song group, with an equal number of males and females in each of these groups.
Materials

A questionnaire booklet was distributed to each participant and included a consent form, a self-report scale to measure arousal, and a debriefing form. Although self-report measures of arousal is not a true biological way to measure arousal, the original Mozart effect research used self-reports to indicate arousal changes in their participants. To measure spatial ability, the Stroop task was administered to all participants. The task was given to the participants through a computer program called Norton Zaps. The participants were required to read a list of colour names printed in a non-concurrent colour of ink. The participants were given a mark for each correct answer completed within time limit of the task. A laptop computer was used to generate either the high arousal or low arousal song, depending on which group the participant was randomly assigned to. The song was preset to play for the duration of the Stroop task, and was set to medium volume.

Procedure

All participants were be given a questionnaire booklet, and were told to sign the consent form in order participate in the study. The study included two different conditions that the participants were randomly assigned to. The conditions included either the Mozart, low arousal and low information load group, or Pop music, high arousal or high information load group. In each group participants were given the same task. Prior to completing the task, participants were asked to self-report their arousal based on how they felt at the time. Upon completion of the arousal scale, the participants were faced towards the computer screen to complete a Stroop task. The Stroop Task is a test of ones mental attention. The participant was required to press the key on the
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computer, either R if the word was printed in red ink, B, if the word was printed in blue ink, or G if the word was printed in green ink. The cognitive mechanism involved in this task is called directed attention, the participant was required to manage their attention, inhibit or stop one response in order to say or do something else. While performing this task, background music pertaining to the specific condition was playing on medium sound level. The participant’s responses were recoded on the computer program Norton Zaps, for the amount of time each response took to complete the task and how many answers they completed incorrectly. The researcher collected data during the trials as well, to ensure accurate reliability and validity. If the participant answered a trial incorrectly, the computer automatically added on an extra trial for each incorrect answer. The purpose of this task is to try and get as many correct answers in the least amount of time possible.

Results

A 2x2 between subjects ANOVA was used to examine the relationship between music style and it’s effect on temporary spatial ability. Since the main effect for music was found to be significant, a post-hoc independent samples t-test was conducted to determine the direction of the significance. Pop music had a significantly lower mean (M= 154.8000) than the Mozart music group (M= 278.6000). Consistent with this result, the post hoc test suggested the Mozart group performed significantly better than the popular culture group, t(18)=4.559, p < 0.05.

These results of the ANOVA for time as the dependent variable can be found in Appendix A, Table 1. The results for incorrect responses as the dependent variable can be found in Appendix A, Table 2. The means and standard deviations for sex and time
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scores can be found in Appendix A, Table. 3. The means and standard deviations for sex and incorrect scores can be found in Appendix A, Table. 4.

Discussion

The present study examined different theories of the Mozart effect, to determine which factor is responsible for the increase of intelligence and performance on a spatial ability task. Initial research has shown that passively listening to Mozart will prime neurons prior to completing a spatial reasoning task, to increase performance. The current experiment paired the spatial ability Stroop Task with either a high arousal or low arousal song, depending on which condition the participant was randomly assigned to. Performance arousal and alertness is suggested to increase while listening to Mozart. The relationship between music and arousal is found in the results of the study. Although one would argue that high arousal, high information load music with an upbeat tempo would increase an individual’s arousal and in turn increase spatial ability, findings from the results suggested otherwise. Mozart music may not directly influence spatial ability, but rather indirectly improve spatial performance by heightening arousal for the specific task. The music in the study acted to optimize arousal in order to affect the way in which a participant performed, rather than necessarily increasing an individual’s spatial intelligence.

The results indicate that the Mozart low arousal group was able to complete the task more accurately, but the participants took more time to complete the task on average than the high arousal group. The Popular culture high arousal group displayed greater signs of arousal, since the music might have affected their motivation to complete the task quicker. Even though participants in this group were more alert, but
they were not accurate in their answer selections.

Conclusions from the study present limitations, which should be amended for further research. Primarily, the main problem was that participants were only given one spatial ability task, and self-reports were used as a measure. Assessments of biological arousal was not conducive to the study but might have predicted more accurate results. Therefore the self-reports in this situation were the most accurate, seeing as college students are able to make judgments on their own arousal. Incorporating more than one spatial ability test in the study could have given more insight into whether the specific music group enhanced performance on the majority of the tasks. Using a limited example does not prove that Mozart music is beneficial to all spatial ability tasks. The spatial ability task requires an individual to solve a problem, which requires minimal preexisting knowledge, and does not explain if music necessarily enhances learning. A future study could test if listening to music prior to entering the classroom affects the way in which an individual learns, or performs on a test with knowledge pertaining to a specific class.

In review of past literature, Jones and Estell (2007), found that Mozart music did not play a role in spatial performance but was related in their sample of high school participants. They suggest that listening to Mozart does not heighten arousal in that age group of students, and students reporting low arousal in either condition did worse on the spatial task than students with high arousal. This notion contrasts the findings from the current study, since the Mozart music was significant in affecting performance on the spatial task, regardless of arousal.

The results of the study indicate that the males in the Mozart group on average spent more time on the spatial ability task, but scored better than the female participants.
in the same group, who on average spent less time to complete the task, and scored worse. In the popular music group, the males again spent longer to complete the task, and completed the task more correctly than the females in that group.

These results lead to a number of conclusions about the study, which may explain the differences between sex, arousal and test taking ability. The students were all given the test at different times of the day, which could have influenced arousal. If all participants were tested at the same time in the day, arousal would generally have been more accurate. The participants were tested in different locations, and extraneous factors could have influenced test taking, or test taking anxiety. The test would be more beneficial if it was held in a specific room, eliminating all external cues, which could have been distractions to the participants, affecting time it took to complete the test correctly. Many University and College students experience exam anxiety, or other stresses and anxieties in their daily life. A self-report of anxiety, or an anxiety scale could have been administered to the participants for the researchers to gage how comfortable the participants were at taking the test.

It would be interesting to perform a longitudinal design on infants listening preferences to music paired with a task, in comparison to the same participants results tested again at later ages in life. This could show a long-term effect of music and it’s relationship to intelligence and learning.

Only through further research will the complexity of the relationship among music, arousal and spatial ability performance be fully understood.
References


Table 1- Summary Table of 2x2 between-subjects ANOVA, with time (s) as the dependent variable.

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
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<td>10215.200</td>
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<tr>
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<td>76632.200</td>
<td>24.472</td>
<td>.000</td>
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<tr>
<td>Sex * Music</td>
<td>6055.200</td>
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<td>6055.200</td>
<td>1.935</td>
<td>.183</td>
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<tr>
<td>Error</td>
<td>50103.600</td>
<td>16</td>
<td>3131.475</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1082184</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
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</table>

Table 2- Summary Table of 2x2 between-subjects ANOVA, with number of incorrect responses as the dependent variable.

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<th>MS</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
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<td>20.000</td>
<td>0.637</td>
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<tr>
<td>Music</td>
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<tr>
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<td>.800</td>
<td>0.025</td>
<td>0.875</td>
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<tr>
<td>Error</td>
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<td>16</td>
<td>31.400</td>
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<td></td>
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<tr>
<td>Total</td>
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<td></td>
<td></td>
<td></td>
</tr>
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</table>

Table 3. Means and standard deviations of popular music and Mozart for the four experimental groups for time

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<tr>
<th></th>
<th>Mozart</th>
<th>Popular Music</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>(n=5)</td>
<td>(n=5)</td>
</tr>
<tr>
<td>( M )</td>
<td>318.600</td>
<td>238.600</td>
</tr>
<tr>
<td>( SD )</td>
<td>91.04559</td>
<td>48.25246</td>
</tr>
</tbody>
</table>
Table 4. Means and standard deviations of popular music and Mozart for the four experimental groups for incorrect responses

<table>
<thead>
<tr>
<th></th>
<th>Mozart Male (n=5)</th>
<th>Mozart Female (n=5)</th>
<th>Popular Music Male (n=5)</th>
<th>Popular Music Female (n=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M$</td>
<td>8.6000</td>
<td>11.000</td>
<td>18.0000</td>
<td>19.6000</td>
</tr>
<tr>
<td>$SD$</td>
<td>3.64692</td>
<td>3.53553</td>
<td>8.15475</td>
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