

Effects of Different Types of Music on Students' Study Efficiency

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Abstract. Music has been omnipresent in people's daily lives; therefore, it is crucial to evaluate how it exerts influence as people depend more on it. Many studies suggest that listening to background music has a positive impact and raises study efficiency, while others suggest that it is counterproductive because it negatively impacts attention levels. These equivocal results occur because people focus on different tasks while testing the effect of background music. This paper explores various effects on students' study efficiency of three genres of background music, classical music, white noise or environmental sounds, and lyrical pop music. Classical music had both beneficial and harmful impacts depending on different cognitive tasks. White noise, surprisingly, has some positive impact on students, especially for ADHD students. Lyrical music has a generally distracting effect on study tasks. Certainly, more research about how three types of music impact students is needed. Since music has become more and more entrenched in people's life, this paper hopes to provide insight into how three types of music can be incorporated into tasks that helps performance and avoid using those that might hurt students' performance.

Keywords: Background music; study efficiency; classical music; white noise; lyrical music.

1. Introduction

Many people believe that listening to music while they are listening to music boosts their study efficiency, and there are lots of types of music to consider while studying. Indeed, music does increase people's arousal and therefore gives them more motivation to work. Gonzalez and Aiello arrived at a different conclusion, stating that music tended to hinder performance on intricate tasks while enhancing performance on straightforward ones [1]. A recent meta-analysis focusing on the impact and effect of Background Music (BM) was done by Velasco and colleagues in 2023. In this review, they found out positive correlation between BM and participants' assessment scores and knowledge retention, therefore arguing that BM is encouraged during instruction because of its beneficial aspects. It's relatively complex to assess the effect of BM on various studying tasks rigorously. Velasco et al. refer to previous studies done by Hallam and MacDonald suggesting that characteristics such as level of difficulty could potentially contribute to the role that background music plays in shaping students' learning experiences [2]. Hence, studies often yield equivocal results on the impact of BM because they focus on different kinds of tasks [3]. For example, people might perform better on a writing task with BM than on tasks that require intricate logic and reasoning. Velasco et al. also account for individual differences while performing the meta-analysis because they notice that for children, BM provides them with a good mood and therefore increases their attention span.

Velasco et al.'s study shed light on the purpose of this research paper because it accessed only one type of BM, while this research paper will focus on the effect of three different types of BM and how they influence students' studying efficiency. The types of BM will be the following, classical music, white noise / environmental sounds, and lyrical music. Specifically, by separating music into these three categories discussed above, students' study efficiency will be examined through different perspectives and categories like memory, attention span, or assessment scores.

2. The Impact of Classical Music

2.1. Effect of Classical Music on Attention Level of School-aged Students

Classical music, as most people are familiar with, typically calms people down and sets people ready for work or study. Therefore, classical music is hypothesized to help students be more focused. Shen was interested in the impact of soft background music on high school students' attention levels. 65 high school students participated in Shen's study, and during the test, each participant was tasked with completing two attention tests, one accompanied by classical background music and the other conducted in silence without any background music. 25 numbers were distributed in a random order, and participants were asked to click the numbers in sequence as quick as possible, then the time of completion and accuracy was recorded. The result showed that both groups finished the test with 100% accuracy. However, it's worth noting that the group exposed to classical background music finished the task faster with an average time of 22.6 seconds, while the group with no background music finished the task with an average time of 23.9 seconds. Under the condition that the data gathered is statistically significant, Shen can conclude that soft (classical) background music without lyrics positively affects participants' attention levels [4]. Thus, it's worth considering using classical music as background music for students to raise their attention level and gain higher study efficiency. However, the drawback of this study is that it only contains a small sample size, as a consequence, it lacks enough representation of the larger population. Further research should focus on choosing a larger sample and replicating the experimental procedures in order to draw a more confident conclusion.

2.2. Effect of Classical Music on Verbal Memory

In 2019, Echaide et al. investigated how background music has an effect on memory for verbal recall. Their argument was that music could act as a context-dependent memory device, therefore, acting as a memory cue, it would be helpful during recall. However, this context effect might not be working here since the purpose is not to measure context effect, thus there won't be a musical condition during recall (i.e., participants won't be listening to any music during recall). Hence, the hypothesis should be classical music has no influence on verbal memory. During the experiment, participants were asked to encode 16 words with no semantic or phonological relationship. The experimental group listened to a piece of music from Mozart while encoding information, while the control group encoded the words in a silent environment. After encoding, two tests were performed. Participants were asked to immediately free recall the words, and after 48 hours, they were asked again to perform a delayed free recall test. However, the results proved that there is no significant difference between the presences of background music on verbal recall. The results only showed how immediate free recall was better than delayed recall. Therefore, Echaide et al. concluded that for both immediate and delayed tests, background music doesn't benefit nor decrease participants' recall performance [5]. Echaide et al.'s experimental results correspond with this paper's hypothesis, indicating that musical conditions might not affect verbal memory. If this experiment is done for the purpose of confirming the context effect, then listening to music might probably be more helpful than the silence condition. This experiment suggests that if there are verbal recall tests, students are free to choose either to memorize using classical music as BM or under silence because they won't affect the recall.

2.3. Effect of Classical Music on Visuospatial Memory

Classical music might hinder visuospatial memory because listening to music might provide people with a mental image of the mood and tempo of the music, which creates conflict with the visuospatial information they are asked to memorize. Therefore, this paper predicts that classical music might hurt people's performance on visuospatial memory. Echaide et al. replicated the experiment where participants were now given 7 geometric figures to memorize, with each figure displayed for 10 seconds, so the researchers could better analyze how music impacts people's

visuospatial processing. Not surprisingly, the results were consistent with Echaide et al.'s hypothesis. In particular, the silence group achieved 60% accuracy during immediate recall, but the background music group performed worse with only 40% accuracy on the same task. The pattern remains the same regarding delayed recall, where the silence group got about 50% accuracy, but the background group fell below 35% accuracy. As a result, Echaide et al. concluded that the experimental results indicate that background music may have a notably negative impact on visuospatial learning [5]. To conclude on how classical music influences people's study and memory, Shen discovered that classical music raises students' attention levels and thus helps them finish tasks relatively quicker [4]. Echaide et al. found that although there is no difference between recall of the words, classical music negatively impacts the memory of geometric figures during immediate and delayed recall [5]. To restate, people should always acknowledge that studies often yield conflicting results on the impact of background music because researchers focus on different aspects of how music influences people's studies and work.

3. The Impact of White Noise or Environmental Sounds

3.1. White Noise Enhanced Verbal Working Memory in ADHD Children

Children with attention-deficit/hyperactivity disorder (ADHD) often demonstrate lower performance in cognitive tasks that demand working memory (WM) because of their hyperarousal states, therefore solutions for this issue are urgently required. Working memory is an ability that stores information so that further cognitive processing can be utilized. Chen and colleagues were thus interested in whether white noise would benefit children with ADHD and improve their verbal WM. To perform the pilot study, 13 ADHD boys were recruited and so were 13 typical development (TD) children. The within-subjects factor was different types of sounds they listened to (i.e., no sound/silence, white noise, and musical condition). Chen et al. used the Digit Span Backward Test from the Wechsler Intelligence Scale for Children to test their verbal WM. Participants were asked to listen to a sequence of digits and repeat the sequence in backward order. The test exhibits a strong split-half reliability ($r=0.96$), and excellent test-retest reliability ($r=0.94$), and is concurrently valid with the WISC-III ($r=0.58$) [6]. Every participant underwent tests with all three auditory conditions. The experimental results showed statistically significant data that ADHD children performed the best after exposure to white noise. As a result, Chen et al. concluded that it's feasible to add white noise for ADHD children to regulate their level of arousal and, consequently, enhance their verbal working memory.

The reason for this conclusion is that white noise acts as a compensator for ADHD children who are often in a low arousal level. As a result, the inclusion of white noise elevates ADHD children's arousal and therefore improves their performance. Chen et al.'s results provide sufficient insight into how to help ADHD students focus on their studies and thus improve their academic performance. It's worth considering adding white noise to school programs for ADHD children.

3.2. White Noise and Reading Comprehension

The adverse impact of distracting stimuli on cognitive performance has always been discussed. Music sometimes also acts as a distractor because it hurts performance under certain conditions. Gheewalla, McClelland, and Furnham explored how three types of auditory conditions exert influence on students' reading comprehension. Namely, silence conditions, white noise, and police sirens. During the experiment, 55 students were recruited. The reading comprehension task consists of one short passage followed by 5 multiple-choice questions, and participants were instructed to respond to the questions with the utmost speed while reaching for high accuracy. Upon analyzing the data, Gheewalla, McClelland, and Furnham found that background noise negatively impacted reading comprehension. Specifically, the silence group took only 135 seconds to answer all 5 questions, but the white noise group took 155 seconds, and the siren group took shockingly 184 seconds. The distinction between the white noise condition and the siren condition was also determined to be

statistically significant ($p \leq 0.001$) [7]. Therefore, it's safe to conclude that white noise also impaired participants' reading comprehension compared to silence given the statistically significant data. Gheewalla and colleagues' conclusion aligns with previous research that background noise impairs people's performance. It's interesting to explore why, compared to sirens, white noise also exerts a negative influence. It's no doubt that hearing a siren raises people's attention and causes them to be cautious because a siren signals danger. However, non-threatening white noise, compared to the high-intensity fearful siren, also slows people down. The reason might be white noise often appears meaningless and boring as a form of musical sound, therefore impacting students' performance negatively. People might consider avoiding listening to white noise while performing reading comprehension based on the experimental data.

3.3. White Noise and Training in Working Memory

Pertaining to training in working memory, this paper hypothesizes that white noise will not be helpful because, once again, the context effect is not evaluated. Borella et al. conducted their study with the objective of investigating whether various forms of music listening could enhance working memory (WM) training in adults. To do this, Borella et al. established three experimental groups and subjected each group to three distinct conditions. One group with fast-tempo classical music (i.e., Sonata K 448 by Mozart), another group with slow-tempo classical music (i.e., Adagio in G minor by Albinoni), and the last group were exposed to white noise. These three experimental groups were compared to a control group that did not listen to any music. To assess gains, Borella et al. used tasks similar to the Categorization Working Memory Span task (CWMS) such as the visuo-spatial backward Corsi blocks task. According to the data and results, Borella et al. found that three trained groups showed training gains on WM, meaning that the three groups outperformed the control group on specific tasks, either immediately or sustained improvement over the long term [8]. Concluding the experimental results, it is worth noting that the white noise group yielded similar results to the two musical groups, showing that white noise does help with WM training. Similar to classical music, studies on white noise also contain equivocal results – either disturbing or stimulating effects of white noise – suggesting that its effectiveness can only be utilized under correct tasks. Therefore, there is no confident conclusion can be drawn from the studies presented, and future research is urgently needed in order to evaluate the feasibility of white noise.

4. The Impact of music with lyrics on Students' Study Efficiency

4.1. Impact of lyrical music on cognitive performance

Lyrical music is always thought to impair students' performance and attention level because the lyrics often act as a distractor, especially during complex tasks. Therefore, this paper hypothesizes that lyrical music will hurt cognitive performance. Marissa Chitwood investigated whether external sound or noise could impair students' cognitive performance. They designed an experiment testing students' reading comprehension performance under three conditions. Participants were assigned in either pink noise, pop music (lyrical music), or silence. Pink noise is a kind of sound similar to white noise, but it more closely imitates the sound of nature and the environment. After allowing participants 8.5 minutes to study the reading passage, and then a test was given. After analyzing and combining data, Chitwood found that the results showed no significant difference in either music or sound in students' performance [9]. The conclusion, therefore, is that the three types of auditory conditions used in this experiment had no effect on students' cognitive performance, and this might suggest that different types of music or noise may not interfere with this cognitive task. This result is quite surprising since lyrical music is hypothesized to be a distractor. However, several problems exist in this experiment. Namely, numerous external variables exist because the experiment is done online. For example, it's possible that participants in the silence group had prior exposure to external noise before the experiment, situations like this are highly influential to the experimental results.

Consequently, additional experiments conducted under a more rigorous setting are necessary to draw a confident conclusion regarding the impact of lyrical music on cognitive performance.

4.2. Impact of Music with Lyrics on Reading Comprehension

It is intuitive to predict the negative impact of lyrical music while performing a reading comprehension task because the brain is processing two different lines of information. However, after introducing Chitwood's experimental results, the impact of lyrical music might be neutral.

Yueying Dong focused on how lyrical music impacts students' reading comprehension. During this within-subject study, participants were assigned 8 GRE-level passages, half of the participants were assigned to the background music condition, while the other half experienced the task without any music. Then, they were given multiple choice questions and the accuracy of responses was recorded. Consequently, Dong's result appears the same as Chitwood's results that were discussed earlier in the paper. In other words, Dong found that background music does not affect reading comprehension [10]. However, although there is no significant effect of lyrical music that Dong observed, from comparing the accuracy of reading comprehension, the silence group attained a higher accuracy score of 64% compared to the background music group which only had 56% accuracy. This indicates that it somehow exerts a negative influence on response accuracy. This paper suggests that more research can be done using multiple challenging levels of reading passages and cross-compare them either with lyrical music or without. What's more, there are more categories under lyrical music, such as fast-tempo and slow-tempo, and researchers can further dive down to assess which type of lyrical music works best for students on reading comprehension.

4.3. Effect of Lyrical Music on Different Cognitive Domains

Drawing from the previous two studies, the paper predicts that lyrical music has no effect on different cognitive tasks. To examine this, Souza and Barbosa concentrated on four domains: verbal and visual memory, reading comprehension, and arithmetic [11]. Then they used a within-subjects design to examine the difference between instrumental and lyrical music, with the silence condition being the control group. There were four tasks that participants had to complete. In the *verbal recall* task, participants were asked to learn lists of words and recall them. Similarly, in the *visual recall* task, 20 images were presented to the participants, and they were asked to memorize them as much as possible. During the *reading comprehension* task, participants were asked to choose the right word to complete the sentence out of five options. For the *arithmetic* task, participants were required to do simple combinations of calculations.

Results for *verbal recall* indicated that the lyrical music group performed the worst among the three experimental groups because the proportion correct is the lowest. It's also no surprise that there is compelling evidence supporting the adverse influence of lyrical music on *visual recall* tasks. It appears that instrumental music is the only type of music that has a positive impact on the *reading comprehension* task's performance, but the data isn't statistically significant. Finally, in the *arithmetic* task, music had no discernible impact on the students' performance. As a result, other than the final arithmetic task, all other three tasks showed detrimental effects of lyrical music compared to silence groups, therefore, Souza and Barbosa's experiment aligns with previous studies showing that music with lyrics has a general distracting effect [11]. The results gained by Souza and Barbosa once again emphasize the importance of recognizing the various effects of lyrical music, or music in general, on different cognitive tasks.

5. Conclusion

Multiple effects of three types of music are assessed in this paper. Classical music helps raise students' attention levels but has no influence on verbal memory. What's more, classical music impairs visuospatial memory. White noise is helpful in the verbal working memory of ADHD children, but it has a pernicious effect on reading comprehension. White noise has no influence on

the training of working memory. Lastly, lyrical music does not affect reading comprehension according to all 3 research papers discussed. Also, lyrical music doesn't impact cognitive performance. To restate and emphasize the main argument once again in this paper, the influence of various types of music seems to vary depending on the specific cognitive task individuals are engaging in. Since music enhances mood and motivation and helps reduce stress and anxiety. Consequently, it would be beneficial to incorporate different types of music into study programs to better aid students. Only abundant research about different types of music underlies the wide application of music. In future research and music application, researchers might utilize or employ different types of music in various study tasks according to the experimental results, therefore better assisting students in achieving academic success.

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