Music and Memory: Effects of Listening to Music While Studying in College Students

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Abstract

Thirty-nine college students participated in an experiment that tested their memory for a text that they studied while in one of the three different auditory settings. Participants were randomly assigned to study a text in silence or while listening to either popular music or classical music. Previous studies have shown mixed performance effects of listening to music while studying a text. The current experiment focused on how college students enrolled at the University of Wisconsin-Stout performed on a test of memory after studying a text in varying auditory environments. The results demonstrated that college students recall more content after listening to pop music or silence during study when compared to classical music.

Effects of Listening to Music While Studying in College Students

Studying is a common activity for college students. Students have an enormous variety of study spaces and situations to choose from, ranging from quiet study rooms to noisy coffee houses. For many students, studying informational materials typically involves some type of background noise, such as television or music. A variety of studies has investigated exactly how music affects learning and memory; with their results pointing to the notion that there are many different factors associated with how music influences how people remember information. The current paper seeks to examine this common and important issue, as listening to music while studying is a

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prevalent behavior for college students.

Researchers have recently examined how background music influences the important cognitive processes involved in reading. Cauchard, Cane, and Weger (2012) investigated the effects on background speech and music on the speed of the participants' reading times via an eye tracking methodology. Specifically, they were interested in whether music or background speech would interrupt important comprehension processes while of reading as indicated by eye movements. The researchers had thirty-two University of Kent students between the ages of 18-29 years old participate in this study. Their eye movement was tracked while they read, and at random points the reading session, participants were interrupted by background speech and music. Despite the fact that some participants were interrupted during reading, most participants only slowed down and re-read the sentences that were interrupted during the noise stimulus. It was also found that there was no deleterious effects, meaning that no information was lost, during the interrupting settings. Moreover, that comprehension of materials read after the interruption was actually better compared to those results from participants that had no interruption at all.

While music can be a distractor for some individuals during performance, it may also provide some benefits. In an office study, Schlittmeier and Hellbruck (2009) investigated the potential for different types of music to block outside noise and increase performance. The authors first examined the detrimental effects of office noise on performance, as well as whether performance could be increased by having music playing. Participants were asked to learn and recall a set of numbers, first in silence, and then while listening to legato music, staccato music, continuous music, or normal office noise. Normal office noise was found to significantly hinder digital recall. In addition, legato music and staccato music superimposed with the office noise also hindered the performance of the participants on the digital recall compared to silence. However, it was also demonstrated that continuous music did help reduce the detrimental effects of office noise on recall of digits.

In addition, Schlittmeier and Hellbruck (2009) asked participants about their musical preferences afterwards and how disrupting the music and noise was as well as their preferences for working while exposed to music or noise. Participants responded that, generally, they preferred to work in silence in the office rather than with outside noise or music.

In a second study, Schlittmeier and Hellbruck's (2009) also sought ways to reduce the disturbance of office noise in isolation from the noise they introduced rather than superimposed with the office. Results showed that only legato music showed any difference in how it affected test performance in the isolation situation, and it did reduce the disturbance of the office noise.

With regard to learning, a study by de Groot (2006) investigated the ability and speed of learning a language while in an environment of music or silence. Thirty-six participants, all of whom were first year psychology students at the University of Amsterdam, were randomly assigned to one of the two environmental settings, music or silence. They were then taught a number of words of a foreign language in silence or while music played. Participants completed three total word-learning sessions, and were brought back in one week later to be retested on the language materials they had learned. Interestingly, participants actually learned foreign language words better while there was music playing compared to silence.

In contrast to the studies summarized above, other studies have found detriments to studying while listening to music. One such study investigated the effects of multi-tasking and performance. Variables that were looked at included; listening to music while writing a work report or any other tasks, or other stimuli physical or visual, around the main task that interrupt the main task. The study found that there was a correlation between multi-tasking and impaired performance on the main task (Konig, Buhner & Murling, 2005). This study shows a further correlation between playing music and poor performance.

In a study done on the self-reported perception of the impact on memory from playing music while studying, Kotsopoulou and Hallam (2010) found that participants in their study chose not to listen to music while studying. This observation appeared to be due to the fact that students perceived that listening to music while studying would impair their ability to study. A study conducted by Furnham and Bradley (1997) appeared to validate this self-reported claim, in that cognitive test performances for both extraverts and introverts was marginally lowered in the presence of music.

In a follow up research study to Furnham and Bradley (1997), Dobbs, Furnham, and McClelland (2011) investigated whether the previously observed difference was due to the task or the presence of background music versus background noise. One hundred and eighteen female schoolchildren between the ages of 11-18 years old participated. Participants were assigned to one of the three sound settings: Silence, background music, and background noise. Participants were then asked to perform a cognitive task, based on their abilities, as measured using Raven's progressive matrices, the Wonderlic personnel test, and a verbal reasoning test. Generally, participants performed better in silence on these cognitive tasks than with music. However, participants in the music setting did notably better than those that were in the background noise setting. The study also showed that there was a positive correlation between extraversion and task performance in the presence of noise of either type of setting, background noise and background music.

Silverman (2007) did a study that looked at the effects of pitch, rhythm, and speech on the abilities of 120 undergraduate college students to perform well on a digital recall test. In essence, it was asking whether students recalled things better if they were simply spoken, or if they were better at remembering things at certain pitches while being spoken. They also wanted to know if there was any effect on the numbers being sung to the participant in rhythm rather than just spoken. The participants were asked to try to remember numbers that were presented to them in four different ways. The first form of stimuli was spoken numbers that they were asked to recall later; the second was spoken numbers paired with a pitch only; the third was spoken numbers paired with rhythm, and finally spoken numbers paired with pitch and rhythm. They were asked to write down the numbers afterwards in the sequence that they were presented. There was no significance between any of the different scenarios and it was suggested that the primacy and recency effect both had something to do with that as well as exhaustion since all participants were subjected to all four stimuli types. While there was no significance, some of the data suggested that there might have been some extra difficulty for students to recall information in the rhythm and pitch mixture stimuli.

The results of this body of research seem to suggest that extraneous sound, including music, has a negative effect on academic performance. Other experiments with regard to memory and music studied the effects of playing a certain type of music while studying. These experiments looked at whether the information could be more efficiently recalled when the same music was played during testing on the studied material. It also was looking at whether it was the tempo, or the musical selection that had the effect on the ability of the participants to recall the studied material. The results were that the recall score was unchanged when the musical selection was changed as long as the tempo remained the same. Conversely, when the tempo was changed, there was a diminished recall score (Balch & Lewis, 1996). The similarities in results across all previously mentioned studies suggest that listening to music while studying has a potentially detrimental effect on academic performance. Yet, these studies appear to either stand in contrast to those examined earlier, in which music did not interfere with or actually enhanced learning: (Alley & Greene, 2008, Cauchard, Cane, &Weger, 2012, De Groot, 2006, Dobbs, Furnham, & McClelland, 2011, Furnham & Bradley, 1997, Konig, Buhner, & Murling, 2005, Kotsopoulou & Hallam, 2010, Schlittmeier & Hellbruck, 2009, and Silverman, 2007).

The present experiment sought to expand on the previous body of research using a sample of students who were probably adept at studying while listening to music. One potential issue with the previous studies is that students potentially did not have much experience studying and learning while listening to music. Specifically the current experiment sought to investigate the performance of University of Wisconsin-Stout undergraduate students on a learning task while listening to music popular music, classical music, or silence.

We hypothesized that students who listened to music while studying a text would recall less information and that students who studied in silence would recall the most information. In addition, we hypothesized that students who listened to pop music while studying a text would recall the least amount of information and that the students who studied in silence would recall the most. We based these expectations on the observation that the popular music contained verbal lyrics, potentially causing the most distraction for the participants during reading. We also hypothesized that classical music would similarly prove distracting to readers compared to the silence condition, but not to the extent as the popular music, due to the lack of lyrics.

Method

Participants

Thirty-nine undergraduate students from the University of Wisconsin-Stout participated in the experiment for course credit. Participants ranged in age from 18 to 22 years old (M = 20.00, SD = 1.95) and 26 were females, 13 were males. Participants were recruited into the study through the University of Wisconsin-Stout internet based participation pool.

Materials

Participants received a packet that contained a short informational text on phosphorus, adapted from Bill Bryson's (2003) book, *A Short History of Nearly Everything*. The text was a single page, and was 530 words in length. In addition, the text packet contained math problems for a distractor task and a recall sheet that contained 10 comprehension questions (see Appendix A and Appendix B). For participants in the popular music condition, the song, Born This Way (Lady Gaga, 2011, track 2) was played during the five-minute reading period. For participants in the classical music condition, Piano Sonata No. 11 in A major (Mozart, 1783) was played during the five-minute period. In the control setting participants read in a silent room.

Procedure

Upon arrival at the laboratory, participants were randomly assigned to either the popular music, classical music, or control (i.e., silence) condition. Participants were seated at a table, given the text packet, and were instructed to read the passage carefully. For participants in the popular and classical music conditions the appropriate music was played at a reasonable volume once participants began reading .Participants in the control condition heard no music or noise during the five-minute reading period.

After the five-minute reading period, the music was stopped and the participants were instructed to turn to the math problem section of the packet. Once participants had completed the math problems, they were instructed to complete the 10 comprehension questions without looking back at the text.

Results

Participant answers on the comprehension questions were assigned one point for a correct answer and zero points for an incorrect answer. Means were first calculated for participants who were exposed to any type of sound during reading and participants who were exposed to silence. Means were then also calculated for each type of noise condition, and all means were then subjected to a one-way Analysis of Variance.

A marginal main effect of sound was observed, in that participants assigned to read the text in the Silence Condition ($M = 6.46$, $SD = 3.95$) produced slightly more correct answers after reading, compared to the Music Conditions ($M = 4.46$, $SD = 3.11$, marginal, $F(1,37) = 2.99$, $p = .09$)(see figure 1). This observation was followed by an analysis to determine an omnibus effect between the three conditions, in which significance was not obtained for Pop Music ($M = 5.08$, $SD = 3.86$), Classical Music ($M=3.85$, $SD = 2.11$), or Silence Conditions ($M = 6.46$, $SD = 3.95$, $F < 1.9$).

Finally, post-hoc comparisons were conducted between the pairs of the three conditions. Interestingly, participants in the Silence Condition produced significantly more correct answers, Compared to participants in the Classical Condition, $F(1,24) = 4.43$, $p = .05$. No other comparisons were significant (all $Fs < 1.0$). No main effect was observed for average reading scores between the pop music ($M = 5.08$, $SD = 3.86$), classical music ($M=3.85$, $SD = 2.11$), and silence conditions ($M = 6.46$, $SD = 3.95$, $F < 1.9$) (see Figure 2).

Discussion

We hypothesized that students who listened to music while studying a text would recall less information and that students who studied in silence would recall the most information. The results from the study were moderately significant when comparing silence and music lending to support our first hypothesis. However, the results comparing pop music, classical music, and silence were not significant and indicated the opposite of what our hypothesis stated, which was that that pop music would damage comprehension of a text during study. These results suggest that the auditory environment has potentially limited influence on college student's ability to study a text. Although participants who studied the test in silence appeared to score slightly higher on the comprehension test compared to both popular and classical music, the findings indicated that silence did better than classical music. These findings would seem to suggest that, for students at the University of Wisconsin-Stout, studying for a test while listening to music may cause little to no detriment to comprehension. Obviously, the simplest explanation for this effect would be that college students are generally better, or at least adept at, studying or performing tasks while listening to music. Indeed, as demonstrated by de Groot (2006), students may learn languages better with music.

However, a variety of outside factors may have also influenced the results of this study. It is possible that many participants were not motivated to participate in the experiment. As the experiment was not part of a class grade, participants may not have put in their full effort to read and understand the text. In addition, it may also be the case that five minutes of reading time was not sufficient for full comprehension of the text. In future experiments, allowing additional or unlimited time to read the test might enable participants to fully comprehend and remember the test.

It is also a possibility that the music was simply not distracting for the participants. Unlike previous experiments that did so (e.g., Cauchard, Cane, & Weger, 2012), the music in this study was not intended to provide a disruption of the study processes used by participants. Participants may have simply not found the provided music samples distracting to their study of the tests. In addition, participants did not listen to the music through headphones, but instead through laptop speakers. The possibility exists that, if participants had been allowed to adjust the music volume, they may have increased the volume level to the point the music caused distraction and damaged performance.

Comments made by some of the participants after completion of the study suggested the popular perception that performance would be harmed by studying while listening to music; an observation mirrored by previous research on college student's perceptions of effective studying (Kotsopoulou & Hallam, 2010). While the perception of performance was not specifically tested in this experiment, the results suggest that reader's belief that listening to music while studying may either harm or help comprehension would potentially correlate with actual performance in an experimental situation.

The findings of this study should be taken with some caution, however. One potential extraneous factor that may have had an impact on performance is that of personal taste in music. For instance, if a participant disliked classical music it may have impaired their ability to focus on the reading task. Another problem is that there are many different types of popular music enjoyed by students at the University of Wisconsin-Stout. For instance, R&B, country, and soft rock are popular music forms enjoyed by students, and the current study did not consider which type of music might cause the most damage to comprehension nor did we include these genres in the current investigation.

In conclusion, although the experiment data yielded only a small significance between the music and no music comparison, when the results were tested breaking the conditions down to pop music, classical music, and silence, there was no overall effect. This was because pop music and classical music cancel each other out. What was observed does matter, a larger sample sized might have yielded significance, though more importantly, the observations reflected that University of Wisconsin-Stout students performed almost equally as well between the silence condition, and the popular music condition. What this may mean for the research is that University of Wisconsin-Stout students are adept at listening to music with lyrics.

On the other hand, classical music may have been more disorienting, simply because it was unfamiliar to the students. If this was the case, then with these results in mind, further study on the effects genre familiarity might have on students' ability to tune out music while performing demanding cognitive tasks may be of interest to educational researchers (e.g., Dobbs, Furnham & McClelland, 2011). Considering the popularity of studying while listening to music, future research should consider this and other important factors that might help better explain the circumstances under which music can enhance or harm learning in college students.

References

Alley, T.R., & Greene, M.E. (2008) the relative and perceived impact of irrelevant speech, Vocal music and non-vocal music on working memory. *Current Psychology*. 27(4). 277-289. DOI 10.1007/s12144-008-9040-z

Balch, W.R., & Lewis, B.S. (1996). Music dependent memory: The roles of tempo change and mood meditation. *Journal of Experimental Psychology*. 22(6). 1354-1363.

Bryson, B (2003). *A short history of nearly everything*. New York : Broadway Books.

Cauchard, F., Cane, J.E., & Weger, U.W. (2012). Influence of background speech and music in interrupted reading: An eye-tracking study. *Applied Cognitive Psychology*, 26(3), 381-390. Doi:10.1002/acp.1837

De Groot, A.B. (2006). Effects of stimulus characteristics and background music on foreign language vocabulary learning and forgetting. *Language Learning*, 56(3), 463-506.doi:10.1111/j.1467-9922.2006.00374.x

Dobbs, S., Furnham, A., & McClelland, A. (2011). The effect of background music and noise on the cognitive test performance of introverts and extraverts. *Applied Cognitive Psychology* 25(2), 307-313. Doi:10.1002/acp.1692

Furnham, A., & Bradley, A. (1997). Music while you work: The differential distraction of the background music on the cognitive test performance of introverts and extraverts. *Applied Cognitive Psychology*. 11. 445-455.

Konig, C.J., Buhner, M., & Murling, G. (2005). Working memory, fluid intelligence, and attention are predictors of multitasking performance and extraversion are not. *Human Performance*, 18(3) .243-266

Kotsopoulou, A., & Hallam, S. (2010). The perceived impact of playing music while studying: age and cultural differences. *Educational Studies*, 36(4). 431-440.

Gaga, L,. & Laursen, J. (2011). Born this way [Recorded by Lady Gaga]. On *Born this way* [Medium of recording: Audio CD, vinyl, and MP3 Music]. Multiple locations: Interscope Records. (2010-2011)

Schlittmeier, S. J., & Hellbruck, J. (2009). Background music as \ noise abatement in open-plan offices: A laboratory study on performance effects and subjective preferences. *Applied Cognitive Psychology*, 23(5), 684-697. Doi:10.1002/acp.1498

Silverman, M.J. (2007). The effect of paired pitch, rhythm, and speech on working memory, as measured by sequential digital recall. J*ournal of Music Therapy*, 44(4), 415-427.

Appendix A

1. When is chemistry said to date from?
2. Robert Boyle of Oxford published the Sceptical Chymist, the first work to distinguish what?
3. What was the name of the man who thought gold could be distilled from human urine and in what year?
4. How many buckets of urine did the chemist collect and where did he collect them?
5. At first, who was called on to provide the raw material to make phosphorus?
6. What was the full name of the chemist that devised a way to manufacture phosphorus in bulk without the slop or smell of urine? And in what year?
7. Name as many of the elements that the poor chemist discovered as you can.
8. Name as many compounds as you can that the same chemist discovered.
9. At what age did this poor chemist die?
10. How did this chemist die?

Appendix B

Chemistry as an earnest and respectable science is often said to date from 1661, when Robert Boyle of Oxford published The Sceptical Chymist —the first work to distinguish between chemists and alchemists—but it was a slow and often erratic transition. Into the eighteenth century scholars could feel oddly comfortable in both camps—like the German Johann Becher, who produced an unexceptionable work on mineralogy called Physica Subterranea, but who also was certain that, given the right materials, he could make himself invisible.

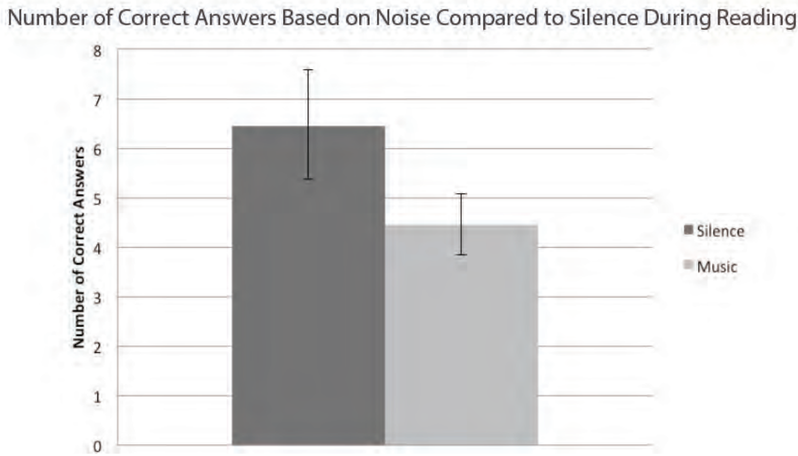
Perhaps nothing better typifies the strange and often accidental nature of chemical science in its early days than a discovery made by a German named Hennig Brand in 1675. Brand became convinced that gold could somehow be distilled from human urine. (The similarity of color seems to have been a factor in his conclusion.) He assembled fifty buckets of human urine, which he kept for months in his cellar. By various recondite processes, he converted the urine first into a noxious paste and then into a translucent waxy substance. None of it yielded gold, of course, but a strange and interesting thing did happen. After a time, the substance began to glow. Moreover, when exposed to air, it often spontaneously burst into flame.

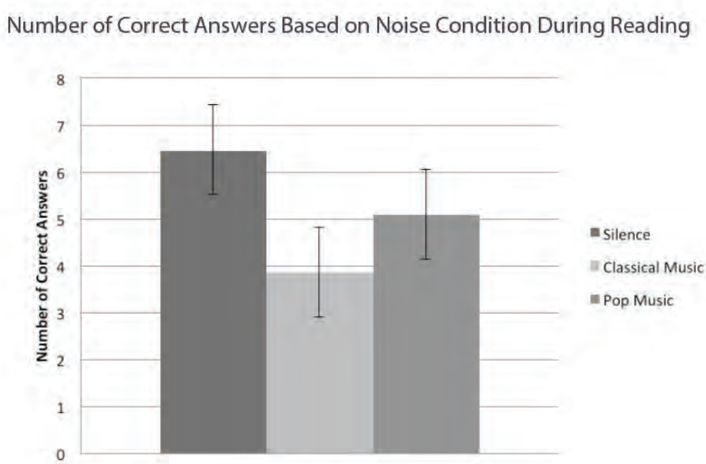
The commercial potential for the stuff—which soon became known as phosphorus, from Greek and Latin roots meaning "light bearing"—was not lost on eager businesspeople, but the difficulties of manufacture made it too costly to exploit. An ounce of phosphorus retailed for six guineas—perhaps five hundred dollars in today's money—or more than gold.

At first, soldiers were called on to provide the raw material, but such an arrangement was hardly conducive to industrial-scale production. In the 1750s a Swedish chemist named Karl (or Carl) Scheele devised a way to manufacture phosphorus in bulk without the slop or smell of urine. It was largely because of this mastery of phosphorus that Sweden became, and remains, a leading producer of matches.

Scheele was both an extraordinary and extraordinarily luckless fellow. A poor pharmacist with little in the way of advanced apparatus, he discovered eight elements—chlorine, fluorine, manganese, barium, molybdenum, tungsten, nitrogen, and oxygen—and got credit for none of them. In every case, his finds were either overlooked or made it into publication after someone else had made the same discovery independently. He also discovered many useful compounds, among them ammonia, glycerin, and tannic acid, and was the first to see the commercial potential of chlorine as a bleach—all breakthroughs that made other people extremely wealthy.

Scheele's one notable shortcoming was a curious insistence on tasting a little of everything he worked with, including such notoriously disagreeable substances as mercury, prussic acid (another of his discoveries), and hydrocyanic acid—a compound so famously poisonous that 150 years later Erwin Schrödinger chose it as his toxin of choice in a famous thought experiment. Scheele's rashness eventually caught up with him. In 1786, aged just forty-three, he was found dead at his workbench surrounded by an array of toxic chemicals, any one of which could have accounted for the stunned and terminal look on his face.


Number of Correct Answers Based on Noise Compared to Silence During Reading
Number of Correct Answers
8
7
6
5
4
3
2
1
0
Silence
Music


Number of Correct Answers Based on Noise Condition During Reading
Number of Correct Answers
8
7
6
5
4
3
2
1
0
Silence
Classical Music
Pop Music