Research Article

Impact of Different Genres of Background Music on a Memory Test

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Abstract: Many studies have examined the effects of different types of background music on cognitive abilities. However, the results of these studies range from finding music to be a significant distraction to finding it to be beneficial. This study examined the effects of different music genres and silence on a memory test. One hundred participants were randomly assigned to four different groups: silence (no music), classical music, rock, and the final group could choose any genre they liked. The California Verbal Learning Test – Second Edition (CVLT-II) was administered to assess participant's memory. Anxiety was also assessed before and after the memory test to see whether the music had any effect. Generally, results suggested that music presence or genre had little tangible effect on memory or anxiety.

Keywords: music, genre, memory, mood

The use of music has become increasingly common, not only is it a source of enjoyment, but it serves many psychological functions and plays a big role in social situations. One study found that 79% of participants reported listening to music while studying (Anderson & Fuller, 2010). Because of this, multiple studies have examined the effects that background music has on different outcomes (e.g., Chew et al, 2016; Kou et al., 2018). These outcomes include, but are not limited to, cognitive abilities, mood, and personality. However, the results of these studies range from finding background music to be helpful to have a negative impact on certain tests. This study contributes to recent literature by focusing specifically on how background music affects memory and mood.

In the next sections of the literature review, we will consider evidence in two realms, namely: memory as well as mood and anxiety. For each section, a few representative studies are presented for each field. This past literature will guide us toward our hypotheses for the current study.

Music and Memory

One study, conducted by Alley and Greene (2008), examined the effects of vocal music, non-vocal music, and irrelevant speech on working memory. Sixty participants were presented with multiple working memory tests and assigned using a quasi-random fashion to each group. Results found that participants in the silent condition performed better while the irrelevant speech condition significantly degraded performance. This study also found that familiarity with lyrics did not have any significant impact on test performance. A similar study that examined the effects of music genre on a memory test was conducted by Bugter and Carden (2012). This study randomly assigned 60 participants to one of three groups: rap music, classical music, or silence. The results of this study found that there was a significant difference between the three groups on the memory test and that participants listening to classical music scored significantly better than those in the rap group. Along with this, it was also found that the silence neither increased nor decreased performance on the test relative to the other two music groups.

Although many studies have found significant findings, some have found null results. Jäncke and Sandmann (2010) examined the effect that music has on verbal learning. The authors randomly assigned 75 participants to one of five different groups. However, instead of using different music genres, this study used music that was not known to the participants. The music varied in tempo (fast vs. slow) and consonance (in-tune vs. out-of-tune) and the final group was exposed to brown noise. Brown noise lowers high frequencies which help creates a deep sound, similar to rushing water. As noted by Jäncke and Sandmann (2010), it is most commonly known for improving relaxation, sleep, and focus. This study did not find any significant influence of background music on verbal learning. Similar to this, a study conducted by Furnham and Stephenson (2007) found that there were no significant differences in test performance between silent versus music conditions.

Given that individual studies may differ in outcomes, meta-analysis can be used to provide a more comprehensive picture of the research literature on memory. A recent meta-analysis was conducted to summarize the effect that background music has on non-musical behavior (Kämpfe et al., 2011). Two separate meta-analyses were conducted; one compared the study with background music to silence and the second one compared the different types of background music. First, a global analysis was conducted on all 97 studies which found there to be no general effect of background music on a variety of tests including cognitive outcomes such as memory and reading. The first question that this study aimed to answer was whether background music has a beneficial or detrimental effect on behavior and cognition. Altogether, the results seemed to show that background music does not affect behavior. However, they were able to find multiple studies that looked at music's effect on sports performance, advertisements, memory, and reading tests. Eight studies were found that examined the effect of background music on a memory test. Between these eight studies, it was found that background music slightly impaired performance overall. Along with this, eight studies that examined music's effect on reading found a generally negative effect. When it comes to the effect that music has on sports performance, a small but positive impact was found. Overall, it seems as though results vary based on the test and whether or not the studies are comparable. While music may have a slightly negative impact on reading and memory, it can also show positive effects on performance in sports.

Music and Mood

Listeners of music often report that music can improve mood, which appears to be a function of mood management, wherein music is used to achieve desired emotional states. Below we note a few representative examples of research addressing this question.

Based on what previous research has found as well as mood management theory, music may be capable of causing a positive or negative mood based on the type of music (Nguyen & Grahn, 2017; Rea et al., 2010; Stratton & Zalanowski, 1994). Along with this, individuals listen to different types of music when faced with certain tests or emotions. A study by Rea and colleagues (2010) examined the effects of three music genres on mood. Each participant was assigned to pop, heavy metal, or classical music group. Mood was measured using the Self-Evaluation Questionnaire STAI Form Y-1 and music preference was measured using the Short Test of Musical Preference (STOMP). The results of this study found statistically significant differences in mood based on the music genre. Participants in

the classical condition reported feeling calmer and more relaxed while those in the heavy metal group reported the opposite. Those in the pop group reported feeling more comfortable and relaxed with a decrease in tension. Along with this, this study also found a correlation between musical taste and mood.

Similarly, a study consisting of three different experiments studied the effect of lyrics versus instrumental music on mood (Stratton & Zalanowski, 1994). Experiment 1 consisted of three different versions of the same depressing song for each of the three groups. The three conditions were melody played on a piano, lyrics without music, and lyrics accompanied by piano. For Experiment 2, the same song was used but three new variations were created. The three conditions included: melody played on piano in an upbeat style, melody and lyrics played on piano in an upbeat style, and singing a song in the original style with new, pleasant lyrics. For Experiment 3, five melodies, including the song used in the first two experiments, were used, along with a control group. Results of these three experiments showed that depressing lyrics led to a negative change in mood, whether or not it had a slow or fast melody. The use of lyrics and melody together had a stronger negative impact on mood than just lyrics alone.

Even edgier music such as heavy metal has been found to have positive mood effects among fans. For instance, heavy metal music has reduced fear of death (Kneer & Rieger, 2016) or other positive emotions such as power, peace, and wonder (Thompson et al., 2019). However, such positive effects appear limited to fans, with negative outcomes more common among non-fans. Thus, we can consider that impacts of music on mood management may be highly idiosyncratic.

The Current Study

The current study aimed to assess whether background music has any effect on a memory test. Recent studies that have been done to examine the effect music has on memory have used digit span tests, self-created word lists, or a concentration game (Bugter & Carden, 2012; Nguyen & Grahn, 2017; Salamé & Baddeley, 1989). These tend to be subjective in nature as compared to standardized testing. Based on this, participants in this study were administered the California Verbal Learning Test, which is a widely used neuropsychological test in America. Along with this, few studies have specifically examined the effect of background music on memory.

Studies within this field of research have used a wide array of music within each study. While most studies tend to focus on instrumental versus lyrical musicals or using varying musical complexities, few studies seem to examine

popular music. For this reason, this study included a group that was able to choose any genre of music per individual. This was done to evaluate if the participants who listen to the music genre they like show a significant difference, whether it was positive or negative, on the memory test. It is also important to note that many studies examine the effect of rap or heavy metal music, and none have specifically used classic rock music, which was used in this study. Thus, hypotheses related to memory and mood are developed from evidence that music generally distracts from memory, but that idiosyncratic effects may be more positive. These idiosyncratic effects have been more clearly shown for impacts on mood, although it is possible that they may affect memory as well.

It was hypothesized that individuals who choose their favorite genre of music would perform better on the memory test than those in specific genres (Hypothesis 1, H1). As well as this, it was hypothesized that the group with no background music would perform better on the memory test than the other three groups (Hypothesis 2, H2). The third hypothesis was that the classic rock group will perform the worst on the memory test out of all other groups (Hypothesis 3, H3). These hypotheses are formulated based on our understanding of the literature that music tends to be distracting for memory, with louder music being the most distracting. For mood, it was hypothesized that there would be no significant difference between participant's mood in randomized conditions due to the idiosyncratic nature of mood management (Hypothesis 4, H4). However, the mood may increase slightly when participants are able to choose their favorite music genre due to this same idiosyncratic.

Method

Participants

One hundred participants from a small, liberal arts college at Stetson University, Florida, United States were recruited to participate in this study. This sample size was selected due to practical concerns regarding time and the size of the student population from which it would be drawn. A prior power calculation using G*Power suggested this sample size was adequate to detect an effect size of $f = .34$, or a medium effect and one which exceeds suggested minimums for interpretation as clinically significant (Ferguson, 2009). The only eligibility criterion was that participants were at least 18 years old. The average age was 20.28 ($SD = 5.08$, range = 18–58). The majority of participants were female ($n = 77$); 23 were male. The majority identified as Caucasian ($n = 66$, 65.3%), 19 (18.8%) were Hispanic, 9 (8.9%) were African American, and 5 (5.0%) identified

as other. Participants were randomly assigned to one of the four groups using a random number generator.

Measures and Music Independent Variable

Music

Each of the four groups was exposed to a different genre of music. Music was played from a set playlist depending on the genre. Group 1 had no music, group 2 listened to classical music, and group 3 listened to rock music. All music played was approximately mid-tempo. Music was provided from a streaming service meaning that all music was entirely random. Participants in group 4 could choose any music genre they liked, this latter being streamed via an online streaming service and, as such, more idiosyncratic than the other groups. All songs were screened for appropriateness and did not contain any explicit content. The music volume stayed soft but loud enough for participants to hear. Music was played at the same volume for each group.

Memory

Participant's memory was assessed using the California Verbal Learning Test – Second Edition (CVLT-II). This test consists of a five-trial free recall (trials 1–5), followed by an interference list and short- and long-delay free recall tests. Participants listened to the prerecorded list of 16 words at one-second intervals in a fixed order. Participants were then asked to recall as many words as possible after each trial. Previous analyses have indicated good reliability and clinical validity of the test (Delis et al., 2000). The word list was prerecorded to ensure the timing was consistent among all four groups. This scale was chosen as it is well-validated and standardized, increasing the applicability of the current analysis to real-world concerns.

Music Preference

Participant's musical preferences were assessed using a 23-item scale called the Short Test of Musical Preference – Revised (STOMPR). Participants were asked to rate 23 different music genres based on a 7-point Likert scale ranging from one to seven (1 = strongly dislike to 7 = like strongly). The four music preference dimensions include reflective and complex, intense and rebellious, upbeat and conventional, and energetic and rhythmic. These dimensions were developed to reflect similarities and differences between certain music genres as they relate to preferences (heavy metal and rock both being intense and rebellious, for instance; blues, jazz, and classical all being reflective and complex, etc.). The scale reliabilities range from α .70 to .81 (Rentfrow & Gosling, 2003). Although subsequent analyses have suggested a 5-factor structure, we observe that the reliabilities for the scales derived from this structure tended to be low (e.g., Rentfrow, n.d.). Thus, we retain

Table 1. Descriptive statistics

	No music	Classical	Rock	Choice
Free recall	47.44 (7.90)	46.64 (8.31)	46.84 (8.27)	50.11 (9.68)
Short recall	−0.22 (1.02)	0.07 (0.71)	−0.36 (1.17)	0.26 (0.93)
Long recall	−0.28 (0.94)	0.09 (0.78)	−0.38 (0.89)	0.34 (1.03)
Mood	33.74 (9.51)	34.45 (9.97)	33.28 (9.56)	36.32 (9.30)

the 4-factor structure scales. This decision was made prior to any analyses.

Mood

The Self-Evaluation Questionnaire STAI-AD Form Y-1 (state anxiety) and Y-2 (trait anxiety) were used to measure participant's mood. The STAI form Y-1 and Y-2 consist of 20 statements each, which people use to describe themselves, including statements like "I feel calm" or "I am jittery." Items are rated on a 4-point Likert scale from 1 = *not at all* to 4 = *very much so*. Summed scores were calculated for pre-test trait and state anxiety as well as post-test state anxiety (the main mood outcome). Scores can range from 20 to 80 with a higher score indicating greater anxiety levels. Alpha coefficients for college students range from .90 to .93 (Spielberger et al., 1983).

Procedure

All participants were randomly assigned to one of the four groups. Participants were tested individually and were not told the specific hypotheses until debriefing. The first group was given the CVLT-II in silence. Group 2 was exposed to classical music, Group 3 was exposed to rock music, and Group 4 was able to choose any music genre.

After being assigned to a music condition, participants were led to the study room. The participants were told that music would be playing in the background as part of a separate study. When participants in group 4 entered the room, they were asked to pick any genre of music they liked and again were told it was for a separate study. Participants were then given a distractor test that consisted of multiple different colored fake flowers. Participants were asked to choose any flower to put in a vase to try and distract them from the music. This test was included to distract participants from the actual study hypotheses. Participants were given the STAI form Y-1 (state pretest) and Y-2 (trait anxiety) when they entered the room and were then administered the CVLT-II. During the 20-minute delay between the Short-Delay Cued Recall and the Long-Delay Free Recall, participants were given a short math test and a word search. These tests were not counted toward their scores, but instead used as a filler to further distract participants from the study hypotheses. Once the CVLT-II was over, participants were given the STAI form Y-1, the STOMP-R,

and a short music listening behavior questionnaire. Demographics were collected at the end of the study and participants were informed of the study's actual hypotheses. Preregistration for this study can be accessed here http://aspredicted.org/blind.php?x=57ue9k. All data is available from Birman and Ferguson (2021) and publicly available at the Open Science Framework (OSF) at https://osf.io/6aqs2/.

Results

All data were analyzed using IBM SPSS statistics 25. A one-way between-subject analysis of variance (ANOVA) was conducted to analyze results among the four groups based on their scores on the CVLT-II. A second one-way ANOVA was conducted for post-test mood scores based on music conditions. All descriptive statistics are presented in Table 1.

For the CVLT there was no significant difference between groups standard score on free recall trials 1–5, $F(3, 96) = .738$, $p = .532$, $r = .087$. There was no significant difference between groups standard score on the Short-Delay Free Recall test, $F(3, 96) = 1.889$, $p = .137$, $r = .138$. There was a significant difference between groups' standard scores on the Long-Delay Free Recall test, $F(3, 96) = 3.131$, $p = .029$, $r = .178$. It is worth noting, however, that were Bonferroni corrections applied to the multiple analyses in this paper, this result would no longer be significant. As such, this result should be interpreted with caution. A planned contrast found that participants who were able to choose their own music ($M = 0.342$, $SD = 1.03$) performed better on the Long-Delay Free Recall test than participants in the rock music group ($M = −0.375$, $SD = 0.89$), $t(96) = −2.72$, $p = .008$, $r = .268$.

Regarding mood, no significant differences were found between the four groups on post-test mood scores, $F(3, 96) = 0.432$, $p = .731$, $r = .067$. Those with no music ($M = 33.74$, $SD = 9.51$), classical ($M = 34.45$, $SD = 9.97$), rock ($M = 33.28$, $SD = 9.56$), and choice ($M = 36.32$, $SD = 9.30$), reported similar levels of mood. Results were essentially identical when reanalyzing the results using analysis of covariance (ANCOVA) to control for trait anxiety and pre-test state anxiety scores, $F(3, 94) = .755$, $p = .522$, $r = .089$. In order to examine if methods variance could

influence results, they were also rerun using difference scores (post–pre state anxiety) instead of using pretest state anxiety as a covariate. This did not change results which remained nonsignificant.

As an exploratory sensitivity analysis, all analyses were rerun with STOMPR scores used as covariates. This did not change any of the results.

Discussion

The purpose of this study was to contribute to the literature on how different types of background music affect memory. Previous studies have shown that many students listen to music while studying. Again, the debate on whether background music produces any positive or negative effects on cognitive abilities overall still continues. The findings of this study indicated that only one significant difference was found between groups based on the Long-Delay Free Recall test on the CVLT-II. No other significant differences were found between the four groups based on the scores of the CVLT-II. As such, all three hypotheses based on music and memory were rejected. This finding is partially consistent with previous research that found no significant differences between groups (Furnham & Allass, 1999; Furnham & Stephenson, 2007; Jäncke & Sandmann, 2010; Nguyen & Grahn, 2017). The only exception regarded a planned contrast found that participants who could choose their own music performed better on the Long-Delay Free Recall test than participants in the rock music group. This was partially consistent with the second hypothesis that participants able to choose their own music would perform better on the memory test as compared to the classical and rock groups.

Regarding mood, evidence from the current study suggested that background music had little impact on mood. However, this finding is not consistent with previous studies which found that music did have an effect on mood (Nguyen & Grahn, 2017; Rea et al., 2010; Stratton & Zalanowski, 1994). This may be due to the fact that in this study the participants were asked to complete separate tests while the music was playing in the background. Along with this, this study was conducted in a way that did not emphasize on the background music. If participants had just been asked to listen to the music and fill out a mood inventory, it is then possible that differences in mood would be seen. Thus, it may be the case that hypothesis guessing drove positive findings in previous studies.

There are several limitations of this study, and the leading one is the sample. This study reported a sample size of predominantly school-aged young adults, with a few older adults. This means that findings from this study are not generalizable to the overall population. Along with this, more than half the sample was female and identified as Caucasian. Nonetheless, our use of distractor tests and the inclusion of a free-choice group provide some novel improvements to some past studies in this area. Our measure of mood focused exclusively on anxiety, although mood encompasses a fuller range of both positive and negative emotions. As such, our results cannot be generalized to other mood-related outcomes.

Further research is still needed to examine the effects that background music has on memory. It would be important for further research to obtain a larger and more diverse sample of participants' age, ethnicity, and gender. Any differences in gender between music preferences and scores between groups may also be worth exploring. More studies are needed to fully explore any significant differences between individuals who listen to their own music compared to individuals who listen to unknown music. We also call on researchers to include more preregistered designs in future research.

In conclusion, we found that background music generally had little impact on memory performance. The only exception was that rock music decreased long-term memory performance. We also found that music had less impact on mood than suggested by some other studies. We hope that our article is a positive contribution to research in this area.

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