

# *The Effects of Musical Arousal on Adolescent Long-term Memory*

Sitong Chen<sup>1,a,\*</sup>

<sup>1</sup>Guangdong Experimental High School AP Curriculum, Guangzhou, 510170, China

a. Cealandds@outlook.com

\*corresponding author

**Abstract:** To examine the effects of different music genres on adolescents' long-term memory. Thirty participants were recruited to take part in the study. First, they were given a list of random letter combinations to memorize while listening to a soothing song or fast-paced rap music. After learning for five minutes, they were given some randomly generated arithmetic questions to complete within two minutes. Then, they did a recognition test on the previously memorized words. Results show that the memory-recalling abilities of the participants while listening to rap or soft music are significantly different. Most participants scored higher in tests with soft music than with rap music. The researcher conclude that it would be beneficial for students to do memorization tasks with relaxing background music because soft music could facilitate the process of information encoding and keep them motivated to study for longer, reducing their stress and anxiety. Students should avoid listening to music with a fast, rhythmic beat while memorizing since this type of music appears distractive. Future research could be conducted with a larger sample size.

**Keywords:** Musical arousal, Long-term Memory, Adolescents

## 1. Introduction

Music listening has long been an essential activity for people, especially teenagers. Music has been proven to have numerous benefits for adolescents and plays a vital role in adolescent development. "Music can influence key aspects of adolescent development – for instance, aesthetics; identity; socialization; emotion regulation and coping; personality and motivation; gender roles; and positive youth development." [1] Music provides teenagers with enjoyment, as well as improvements in emotional mood, social relationships, and overall well-being. Listening to music also allows teenagers to portray an "image" to the outside world, strengthening their cognitive abilities [2,3]. In addition, music can help adolescents express themselves and build close connections with peers who share similar interests and preferences; it helps them explore and understand their emotions; it allows them to step away from the stresses and strains of everyday life and thoroughly immerse themselves in something that they enjoy, considerably alleviating their pressures and anxiety.

Recent studies suggest that around 60% of students play music while studying. Some adolescents state that listening to music when studying allows them to concentrate on their work since they feel less stressed and anxious with background music. Additionally, studies show that listening to music while studying enables students to feel more motivated and active [2]. Research investigating different genres of music and their effects on mood, tension, and mental clarity was conducted, and

144 participants were involved in the study. The study results demonstrate that listening to music while studying improves relaxation, positive feelings, and mental clarity substantially [4]. The genre of the music played is also crucial to the level of cognitive performance. Studies show that soft music vastly decreases anxiety, anger, and other negative feelings. At the same time, it increases relaxation, which provides students with a comfortable and soothing environment for information processing [5,6]. Therefore, students and educators need to learn the effects of different sorts of music on adolescents' long-term memory so that students can find more applicable ways of studying and provide a better educational environment for students to learn. Current studies on music's impact focus on music's effects on individuals' cognitive performance, while only a limited amount of research specifically analyzed adolescents' long-term memory.

This work examines the influence of different types of musical interventions on adolescents' long-term memory. Firstly, participants in the study were asked to listen to fast-paced rap music while memorizing some nonsense words. Then, they did a set of two-minute arithmetic questions for distraction. Later, they completed a recognition test on previously learned words. Then they repeated the steps again but with tranquil, soft music. Meanwhile, the researcher used 3-item Likert Scales to record the participants' emotional states before memorizing and the self-assessments of their abilities to remember. The researcher hypothesizes that soft music enhances long-term memory during adolescence better than rap music.

## 2. Literature review

Whether to play music while studying or not has been a controversial topic and numerous studies have been conducted to explore this area. Research has shown that music could affect memory negatively in terms of remembering knowledge points or vocabulary and that students are better able to memorize without music [7]. However, studies also illustrate that musical arousal significantly helps with analysis. Specifically, playing music can keep students studying longer by making the process less tedious. Music also improves academic performance by keeping students concentrated and motivated so they would enjoy exploring more [8]. Before examinations or quizzes, students usually review previously learned knowledge, such as vocabulary and mathematic formulas. In these instances, picking an appropriate song to listen to while memorizing can be enormously helpful in reducing nervousness and improving concentration.

Students who play music while studying typically listen to their favorite playlists, which usually contain various music genres such as Jazz, rock, classical, pop, etc. Nevertheless, it's essential to consider what specific types of music help with study so that they can choose songs that keep them focused and motivated while studying. Moreover, selecting the right music can keep students from being distracted by their surroundings, allowing them to do their work more efficiently. Recent studies suggest that music can influence people's mood and arousal, putting people at optimal levels to enhance memory performance. An experiment studying the effect of background music on different types of memory was conducted. The researchers use different sorts of music that create different mood and memory contexts to investigate the impact of mood, arousal, and context on the performance of recall, recognition, and associative memory tasks. The results indicate that low-arousal music strengthens recall and recognition memory more than high-arousal music [9]. Low-arousal music is peaceful and soothing, like soft or classical music, which people often listen to before bed.

Adolescents should also know how to use music to improve their academic performance. Studies have shown that playing music when individuals encode information promotes item recognition, and doing so decreases activities in the dorsolateral prefrontal cortex, which would foster cognitive performance [10]. Therefore, properly using music while learning can help with academic tasks like reading or memorizing. Research conducted by Goltz and Sadatoka investigated how people can use

music to optimize their cognitive performance. The research examined the usage of background music (BGM) on reading comprehension, memory, reasoning, writing, and general attention. The study recruited 140 university students to take part in the study. They were asked to fill in online questionnaires about their usage of BGM during some daily cognitive activities, including reading, writing, memorizing, and critical thinking. The study results demonstrate that the students listen to music when they study because they think the background music can brighten their mood and keep them concentrated. In addition, some of them mentioned using themes to keep them awake or motivated during study sessions.

Furthermore, the difficulty level of the tasks impacts the choice of music genres. The study's outcome indicates that people tend not to listen to music when the jobs are challenging, and they become more selective when the tasks get more complex. People prefer listening to non-vocal, calm, and classical music while performing daily tasks. Lastly, the results of a survey of different questions suggest that half of the participants agreed that music helps them concentrate on studying, and 69.29% of the participants think that they cannot focus their attention without background music. According to the statistics, non-vocal, calm, and classical music barely distract their concentration while studying, and jazz, upbeat, vocal, and pop music often distract them [11]. Thus, it is beneficial for students to pick calming and soothing songs as background music when studying, especially for memorizing tasks, and they ought to avoid complex and fast-paced music since these types of music appear to be distracting.

Additionally, lots of studies indicate that people's moods are also associated with memory performance. Take mood-congruent memory, memory encoded when people's mood state is consistent with the affective tone of the information, as an example. During mood-congruent encoding, individuals are better able to learn the material's content if their mood states are the same as the material's affective tone. More specifically, if individuals are happy when they are learning, they will encode positive information better [12]. Moreover, being in a pleasant mood facilitates cognitive performance [13,14]. Thus, using music properly to boost individuals' mood states could benefit memory performance. Research suggests that music can induce mood during the MMIP (musical mood induction procedure), and music can be utilized as a tool to enhance individuals' performance [15]. Music therapy has been used as a therapeutic approach to help patients with psychological disorders for hundreds of years, and various studies show that music improves mood states [16-19]. Research was carried out to study music interventions and their effects on mood and depression in neurological patients. The researchers elucidate that music is associated with many areas of the brain. Hence, music interventions have facilitated socialization and cognitive, emotional, and neuromotor functioning. Neurologic music therapy (NMT), which aims to help neurological patients, can activate perception and production areas in the human brain to further enhance sensory, cognitive, and motor dysfunctions caused by neurological disorders. Besides, simply listening to music without a specifically trained therapist improves patients' mood states, stronger motivation, and decreases depressive symptoms [20]. Hence, students could listen to music before memorizing tasks to relax and improve efficiency.

### **3. Method**

#### **3.1. Participants**

Thirty high school students (ranging in age from 16 to 18) from Guangdong Experimental High School AP Curriculum participated in this study. There are 17 females and 13 males. All students were informed about the content and risks of the study, and they all took part voluntarily. Researchers debriefed the results of the survey with the participants afterward.

### 3.2. Materials

Two songs from different music genres are used in this research to study the effects of different types of music on teenagers' long-term memory. Soft music is defined as relaxing and comforting music, and the song "Yellow" (Vancouver Sleep Clinic, 2022) is used in the study. Rap music is upbeat and rhythmic, and the song "Godzilla" (Eminem/Juice WRLD, 2020) was used in this study as rap music. Words participants memorized are nonsense letter combinations. Furthermore, 100 elementary arithmetic questions randomly generated are also used in the study.

### 3.3. Procedures

The experiment was conducted in Guangdong Experimental High School AP Curriculum self-study rooms. Each participant was tested alone so that they would not be distracted by others. All participants signed the informed consent forms before starting. In the beginning, students were given two 3-item Likert scales to rate their mood (1: not so happy; 1: relaxed; 3: glad) and to rate their ability to memorize (1: spend too much time on learning; 2: spend a lot of time on memorizing; 3: can memorize vocabulary effectively). First, Students were given a randomly generated list of 15 nonsense letter combinations and had five minutes to learn the list. While learning, they listened to the rap song "Godzilla" with earphones on. All participants listened to the music with the same volume level (50%). After memorizing, they were asked to do some elementary arithmetic questions as a distraction. They were given Fifty arithmetic questions, and they were asked to finish as many questions as possible in two minutes. Then, the instructors would show the participants nonsense letter combinations, including those they had memorized earlier. They would be asked whether they have learned the combinations before or not. Meanwhile, researchers recorded how many varieties they recognized. After the first round of tests, students rested for one minute. Then, the subsequent trial began, and participants were given another list of randomly generated nonsense letter combinations. When remembering the words, they all listened to the song "Yellow" with earphones. After 5 minutes of memorizing, 50 different arithmetic questions of the same difficulty level were presented to the students to complete. Similarly, they were presented with nonsense letter combinations, including some of the varieties they memorized earlier. To avoid the order effect, which occurs in repeated measures designs when the order of the test influences participants' responses, half of the participants listened to the two types of music in a different order to counteract the effect. Additionally, the operational definition of a good mood in this study is when the participants rate themselves a three on the 3-item Likert Scale.

### 3.4. Statistical Analysis

Descriptive statistics were obtained for all the participants. Bivariate correlational analyses (Pearson, 2-tailed) were performed between the age of all the participants, the style of music-listening (including soft and rap), their mood, and memory ability before conducting the memorizing tasks. All analyses were calculated using Statistical Package for the Social Science (SPSS 27.0).

## 4. results

The participants' Demographic information and memory ability levels are shown in Table 1. Thirty adolescents aged 15 to 18 (43% males) participated in the study. Their stories of memory ability were tested by recalling random combinations of letters; before that, the subjects were required to remember those combinations while simultaneously listening to rap or soft music. It can be found that listening to soothing music can typically result in better recalling of the letters ( $M = 7.80$ ,  $SD = 1.73$ ) compared to listening to rap music ( $M = 6.63$ ,  $SD = 1.43$ ).

Table 1: Descriptive statistics of all the participants and their levels of memory ability when listening to rap and soft music.

	N	Minimum	Maximum	Mean ± SD
Age (years)	30	15	18	16.73 ± 0.83
Gender (males: females)	30	NA	NA	13:17
Rap	30	4	9	6.63 ± 1.43
Soft	30	5	10	7.80 ± 1.73

Paired samples t-tests (2-tailed) were further conducted to examine the difference in nonsense word recalling ability between listening to rap and soft music. The result showed a significant difference in terms of memory ability while listening to different kinds of music [ $t(29) = -4.00$ ,  $p < .001$ ], indicating that listening to appealing music when memorizing things appears to enhance long-term memory better than fast-paced music (also see Table 1).

Pearson correlations analyses (Pearson, 2-tailed) were then performed, and part of the results are shown in Table 2. The Pearson correlation coefficient ( $r$ ) value between age and rap is 0.382, which means there is a moderate positive correlation between age and rap. So, as participants' ages increase, they seem to score higher in the tests on rap music, indicating that older adolescents may be better at using rap music to help themselves learn and memorize rather than as distractions. A strong positive correlation ( $r=0.486$ ) is shown between rap music and participants' mood states right before the study began, so this implies that adolescents in more positive moods while memorizing can memorize more things when listening to rap music than soft music. A positive correlation ( $r=0.395$ ) between soft music and memory suggests that participants who rate their memorizing abilities tend to score high in benign music conditions.

Table 2: Bivariate correlational analyses (Pearson, 2-tailed) between variables of age, rap, soft, mood, and memory, in which rap and smooth represent the kind of music the subjects listened to when memorizing nonsense letter combinations, philosophy, and memory, show the emotional situation and memory ability of the issues acquired before the memorizing tasks, respectively.

	r	p
Age and rap	.382	.370
Age and soft	.323	.082
Rap and mood	.486	<b>.006</b>
Soft and mood	.579	<b>.001</b>
Rap and memory	.355	.054
Soft and memory	.395	<b>.031</b>

## 5. discussion

This study presents an alternative perspective on the impact of different kinds of musical arousal on adolescent long-term memory. The researcher use a repeated-measured design to examine the effects



of two specific music genres (soft music and rap music) on individuals' abilities to memorize some nonsense letter combinations. During the study, participants were asked to listen to either a soothing or rap song first while remembering. Then, after a short period, they did a test on recognizing the combinations they learned earlier. Then they repeated the steps again but with another song. In line with the study's hypothesis, listening to soft, calming music while memorizing is advantageous to long-term memory, whereas listening to fast-paced music does not have equally beneficial effects. According to the results in Table 1 and of paired samples t-test (2-tailed), the study outcomes demonstrate a correlation between soft music listening and higher scores in recognition tests. Thus, listening to soothing music while memorizing would benefit teenagers to enhance their knowledge. The results fit with the study conducted by Ferreri et al., which investigated the effects of music on memory encoding and prefrontal cortex (PFC) activity. The results indicate that background music during the encoding stage facilitates retrieving encoded information. The decrease in activation of the dorsolateral prefrontal cortex (DLPFC) improves neuronal efficiency, which further helps with recognition memory [10]. Moreover, the outcomes of the present study are also by the research on the effects of music on memorization performance performed by Ahmad et al., which illustrates that listening to music while memorizing improves memorization performance by enhancing the use of the right brain [21]. Furthermore, gentle and mild music, like classical music, improves memorization performance better than any other type of music [21]. Therefore, this study contributes a clearer understanding of the improvements in memory that relaxing music can provide for individuals.

However, the small sample size limits the results' generalizability. Although the hypothesis is supported by the significance inferred from the statistical analysis, a larger sample size would help generalize the results to adolescents in the broader age range. The use of self-assessment to rate the participants' abilities to memorize could also be a limited factor. Participants rated their ability to learn using a 3-item Likert Scale. In this way, the results could be biased because of socially desirable answers, which means some participants may give untruthful answers to make themselves look good. Another limitation of the study could be the information about participants' moods collected before they listened to the music. The researcher can examine the correlation between mood and memory.

In contrast, the correlation between mood and music cannot be inferred from the study due to the different approaches used to estimate their memory-recalling abilities. In addition, personal preference could be a potential confounding variable. For instance, there is a chance that the individual scores higher on soft music tests because the person personally prefers soft music more. So, the individual feels more relaxed and enjoys the comforting music.

One of the future works could work on extending the sample size to demonstrate the generalizability and robustness of the present study. Additionally, cultural differences could be considered by including younger adolescents and teenagers from different regions or countries. In terms of optimizing our current research, future studies should have the participants memorize the nonsense words in a silent condition, without listening to music, and then give them the recognition test. This way, the results of the tests can be used to evaluate their memorization abilities. The test scores can be compared to the two other tests (i.e., rap and soft). Hence, the study would be better able to provide insights into which sort of music facilitates memorization abilities more. Moreover, further research should consider the participants' mood states before the study begins. Ensure all participants are in similar emotional states so they will not be distracted while memorizing by excessive preoccupation.

## 6. Conclusions

This study investigates the effects of two music types (rap and soft music) on adolescents' long-term memory. The results indicate that playing peaceful and relieving music while memorizing can improve memorization better than listening to fast-paced music. Adolescents should avoid using

upbeat and rhythmic songs as background music since those kinds of songs would distract their attention. Calming and appeasing music could be an excellent choice to promote memorization when they are studying. However, the small sample size partially limits the study's outcomes. Future research should operate with a bigger sample size. The current study is based on the theory that improvements in memory when memorizing can be induced by relaxing music.

## References

- [1] Miranda, D. (2013). *The role of music in adolescent development: much more than the same old song*. *International Journal of Adolescence and Youth*, 18(1), 5–22. <https://doi.org/10.1080/02673843.2011.650182>
- [2] Boal-Palheiros, G. M., & Hargreaves, D. J. (2001). *Listening to music at home and at school*. *British Journal of Music Education*, 18(02). <https://doi.org/10.1017/s0265051701000213>
- [3] North, A. C., Hargreaves, D. J., & O'Neill, S. A. (2000). *The importance of music to adolescents*. *British Journal of Educational Psychology*, 70(2), 255–272. <https://doi.org/10.1348/000709900158083>
- [4] McCraty, R., Barrios-Choplin, B., Atkinson, M., & Tomasino, D. (1998). *The effects of different types of music on mood, tension, and clarity*. *Alternative Therapies in Health and Medicine*, 4(1), 75–84. <https://europepmc.org/article/med/9439023>
- [5] Labbé, E. E., Schmidt, N. P., Babin, J., & Pharr, M. (2007). *Coping with Stress: The Effectiveness of Different Types of Music*. *Applied Psychophysiology and Biofeedback*, 32(3–4), 163–168. <https://doi.org/10.1007/s10484-007-9043-9>
- [6] Jiang, J., Zhou, L., Rickson, D., & Jiang, C. (2013). *The effects of sedative and stimulative music on stress reduction depend on music preference*. *Arts in Psychotherapy*, 40(2), 201–205. <https://doi.org/10.1016/j.aip.2013.02.002>
- [7] Musliu, A., Berisha, B., Musaj, A., Latifi, D., & Peci, D. (2017). *The impact of music in memory*. *European Journal of Social Science Education and Research*, 4(4), 138–143. <https://doi.org/10.26417/ejser.v10i2.p222-227>
- [8] Hope, A. (2019, August 2). *7 Benefits Of Listening To Music While Studying*. Music Gateway. <https://www.musicgateway.com/blog/how-to/7-benefits-of-listening-to-music-while-studying>
- [9] Nguyen, T., & Grahn, J. A. (2017). *Mind your music: The effects of music-induced mood and arousal across different memory tasks*. *Psychomusicology: Music, Mind, and Brain*, 27(2), 81–94. <https://doi.org/10.1037/pmu0000178>
- [10] Ferreri, L., Aucouturier, J., Muthalib, M., Bigand, E., & Bugaiska, A. (2013). *Music improves verbal memory encoding while decreasing prefrontal cortex activity: an fNIRS study*. *Frontiers in Microbiology*, 7. <https://doi.org/10.3389/fnhum.2013.00779>
- [11] Goltz, F., & Sadakata, M. (2021). *Do you listen to music while studying? A portrait of how people use music to optimize their cognitive performance*. *Acta Psychologica*, 220, 103417. <https://doi.org/10.1016/j.actpsy.2021.103417>
- [12] *Handbook of Cognition and Emotion*. (n.d.). Google Books. <https://books.google.com/books?hl=zh-CN&lr=&id=vsLvrhohXhAC&oi=fnd&pg=PA193&dq=effects+of+mood+on+memory+performance&ots=uUCMboX6Ie&sig=kclc09ESDmLGYvw5coPmlcyeDQ0#v=onepage&q&f=false>
- [13] Grol, M., Koster, E.H.W., Bruyneel, L. & De Raedt, R. (2014). *Effects of positive mood on attention broadening for self-related information*. *Psychological Research* 78, 566–573. <https://doi.org/10.1007/s00426-013-0508-6>
- [14] Lee, A. Y., & Sternthal, B. (1999). *The Effects of Positive Mood on Memory*. *Journal of Consumer Research*, 26(2), 115–127. <https://doi.org/10.1086/209554>
- [15] Västfjäll, D. (2001). *Emotion induction through music: A review of the musical mood induction procedure*. *Musicae Scientiae*, 5(1\_suppl), 173–211. <https://doi.org/10.1177/10298649020050s107>
- [16] Shuman, J., Kennedy, H., DeWitt, P. E., Edelblute, A., & Wamboldt, M. Z. (2016). *Group music therapy impacts mood states of adolescents in a psychiatric hospital setting*. *Arts in Psychotherapy*, 49, 50–56. <https://doi.org/10.1016/j.aip.2016.05.014>
- [17] Bittman, B., Bruhn, K. T., Stevens, C., Westengard, J., & Umbach, P. O. (2003). *Recreational music-making: a cost-effective group interdisciplinary strategy for reducing burnout and improving mood states in long-term care workers*. *Feature article*, 19(3/4), 4–15. <https://psycnet.apa.org/record/2003-10365-002>
- [18] Bittman, B., Snyder, C., Bruhn, K. T., Liebfreid, F., Stevens, C., Westengard, J., & Umbach, P. O. (2004). *Recreational Music-making: An Integrative Group Intervention for Reducing Burnout and Improving Mood States in First Year Associate Degree Nursing Students: Insights and Economic Impact*. *International Journal of Nursing Education Scholarship*, 1(1). <https://doi.org/10.2202/1548-923x.1044>
- [19] Biagini, M. S., Brown, L. E., Coburn, J. W., Judelson, D. A., Statler, T., Bottaro, M., Tran, T. T., & Longo, N. (2012). *Effects of Self-Selected Music on Strength, Explosiveness, and Mood*. *Journal of Strength and Conditioning Research*, 26(7), 1934–1938. <https://doi.org/10.1519/jsc.0b013e318237e7b3>

- [20] Raglio, A., Attardo, L., Gontero, G., Rollino, S., Groppo, E., & Granieri, E. (2015). *Effects of music and music therapy on mood in neurological patients*. *World Journal of Psychiatry*, 5(1), 68. <https://doi.org/10.5498/wjp.v5.i1.68>
- [21] Ahmad, Y., Zainon, F., Ghazali, Z., Man, N., Alipiah, F. M., & Mohamad Yunus, M. Y. (2017). *The Influence Of Music On Memorization Performance Of Mathematics Students*. *Proceedings of The ICECRS*, 1(2), picecrs.v1i2.1443. <https://doi.org/10.21070/picecrs.v1i2.1443>