Original Research Article

Exploring the Impact of Emotional Congruence in Music on Memory Recall of University Students: An Experimental Study

ABSTRACT

Aims: This study examined the conditions under which music influences memory recall, focusing on the effects of emotionally congruent music, emotionally incongruent music, and the absence of music on memory performance.
Place and Duration of Study: The study was conducted at a private university in Digos City. Data collection took place during the latter half of the 2024 academic semester to enhance the accuracy and reliability of the findings, as participants were expected to engage with minimal academic distractions.
Methodology: The research design is a true experimental between-group research design involving random assignment to ensure high internal validity. 45 participants were randomly assigned during the experiment.
Results: This study aimed to determine whether music and emotional congruence significantly affect memory recall. The Kruskal-Wallis test, a non-parametric alternative to one-way ANOVA, was employed to analyze the data. The chi-squared statistic $\chi^2 = 3.76$, with $df = 2$, assesses differences in memory recall across three conditions: Emotionally Congruent, Emotionally Incongruent, and No Music. The effect size was calculated as $\varepsilon = 0.0854$, indicating that approximately 8.54% of the variance in memory recall was attributed to the emotional congruence of the music. However, the small effect size suggests these differences have limited practical significance. Additionally, with a p-value of 0.153 ($p > 0.05$), the results demonstrate no statistically significant effect of music and emotional congruence on memory recall.
Conclusion: This study has several limitations that may affect the significance of its findings, such as participants' emotional states, past experiences, and environmental factors like lighting, temperature, or noise. To address these issues, future research should consider using a standardized setting, ensuring consistent participant preparation, and including more similar characteristics between groups to enhance internal validity. The study will be replicated with stricter controls to validate further and improve the findings, and external variables will be examined more closely. Additionally, while the experimental design provides valuable insights, its conclusions may be less generalizable. Future studies could adopt correlational designs to expand and complement these findings.

Keywords: Memory recall, Emotionally congruent music, Emotionally incongruent music, True experimental research design

1. INTRODUCTION

Does the emotion evoked by music shape what we remember? Music has significantly influenced many cognitive and emotional processes, including focus, association, and memory (Koelsch, S. 2014). The fact that music can either be distracting or elevating remains an enigma in music psychology. It was

hypothesized that if an individual feels emotion as a response to music, their cognitive processes are affected (Talamini, F., Eller, G., Vigl, J., & Zentner, M., 2022). In line with this, the study aims to explore how the emotional congruence of music affects memory recall. In particular, the question lies on the effectiveness of mood-appropriate music in recalling specific details from the content of focus.

One of the core issues in the psychology of music was whether or not music can improve or hinder performance in various tasks (Naranjo, Beatriz & Rojo Lopez, Ana M., 2021). Several studies have been conducted on music congruence. One study focused on the effects of music congruence (Indian, American, and Chinese music) on purchasing behavior, specifically on Indian, American, and Chinese food. Results have found that participants are likelier to choose food that matches the music playing in the background (North, A. C., Sheridan, L. P., & Areni, C. S., 2016). On the other hand, a study has also been conducted about the emotional congruence of music on memory retrieval. However, facial expressions were utilized. The study found that cues encoded with emotionally incongruent stimuli (joyful music with sad facial expressions) trigger more memories than cues with emotionally congruent stimuli (joyful music with images of joyful facial expressions). Moreover, it has been revealed that memories triggered by music are dictated by this “incongruence effect” (Panteleeva, Y., Courvoisier, D. S., Glowinski, D., Grandjean, D. M., & Ceschi, G., 2022).

Previous research on the influence of music on memory recall presents mixed findings. While some studies suggest that music may enhance memory, others report negligible or even adverse effects. This research addresses these gaps by investigating the specific conditions under which music can improve memory recall. This study will contribute to the field by providing more precise insights into the impact of music on memory recall under controlled conditions, including the influence of music congruence on memory recall. The findings could be valuable for educational and therapeutic settings, aiding in developing better strategies for using music to support memory, learning, and cognitive rehabilitation.

This study attempts to elaborate on the effect of musical emotional congruence on memory. In this case, a story has been utilized as the source of the specific details that will be used on an assessment to be answered by the participants to answer the following questions:

1. How does emotionally congruent music influence memory recall compared to emotionally incongruent music and no music?
2. Is there a significant difference in memory recall between participants exposed to emotionally congruent music, emotionally incongruent music and those who experience no music?

To fill the knowledge gap about how music influences cognitive processes, particularly memory recall, this study intends to investigate the impact of emotional congruence in music on memory retention. This study aims to shed light on the circumstances in which music might either enhance or impair memory recall by examining the effects of music's emotional alignment with the task (for example, pleasant music for cheerful content). The research will investigate the impact of emotional incongruence, which suggests that mismatched music and content can improve memory recall (Panteleeva et al., 2022). The findings could provide valuable insights for practical applications in education, therapy, and environments that require enhanced memory and focus, offering evidence-based recommendations for using music to optimize cognitive performance.

Bower (1981) offers a framework for comprehending how emotional congruence in music affects memory recall through his semantic associative network model of memory. This paradigm states that specific memory nodes, which house associated memories, occurrences, and associations, are connected to emotions. Depending on the mood it creates, music, which is well known for its capacity to

arouse emotions, can activate these emotional nodes. Happy music, for example, may engage the "happy" emotional node, which helps people remember good experiences. In contrast, sad music may activate the "sad" emotional node, which makes terrible memories easier to access. Mood-congruency effects, which hold that people are more likely to recall information in line with their present emotional state, are compatible with this process.

In an experimental study exploring emotional congruence in music, the emotional tone of the music would interact with the participant's mood, potentially influencing the ease and accuracy of memory recall. When the music's emotional content matches a specific memory's emotion, the emotional node associated with that memory is activated, making it easier to retrieve congruent memories. This aligns with Bower's model, where mood-congruent cues, such as music, enhance memory recall by activating related emotional networks. Conversely, mood-incongruent music may hinder recall, as it activates emotional nodes that are less connected or even oppositional to the memories being sought. Thus, emotional congruence in music is a powerful cue influencing memory retrieval by activating mood-linked memory networks.

2. MATERIAL AND METHODS

This section describes the methodology used in the study, allowing others to replicate the experiment.

2.1 Participants

The study participants were 2nd-year students of UMDC (N=45) from 3 different programs (BSED-English, BSED-FM, and BSED-Social Studies). The BSED-English was composed of 21 students, the BSED-FM was composed of 15 students, and the BSED-Social Studies was composed of 9 students. The majority of the participants were from the BSED-English program. Their age group ranges from 18-23. These participants were selected through random sampling.

2.2 Design and Statistical Methods

The study utilized a true experimental research design with random assignment to effectively differentiate the results of memory recall across the three conditions, wherein 15 participants were randomly assigned to each group. The experimental methodologies require at least 15 participants, according to Cohen et al. (2007:102), and there should be at least 15 participants in control and experimental groups for comparison, according to Gall et al. (1996). During the experiment, the participants were tasked to read a given story and answer the following questions. A qualified professor checked the reading material and the questionnaire to ensure that the contents aligned to measure the participants' memory recall effectively. In addition, the researchers used a normality test, specifically the Shapiro-Wilk test, to determine whether the sample data had been drawn from a normally distributed population. It is generally performed to verify whether the data involved in the research have a normal distribution. Next, the researchers used descriptive statistics, a method used to summarize and describe the main features of a dataset. This includes measures of central tendency, such as mean, median, and mode, which provide information about the typical value in the dataset. Lastly, the researchers used Kruskal-Wallis, a non-parametric alternative to one-way ANOVA, to find if there is a significant effect in terms of music and emotional congruence on memory retention. This was used to figure out if there was a substantial effect in terms of music and emotional congruence on memory retention.

2.3 Instruments

The researchers utilized pre-existing story from the Internet. During the experiment, the participants were tasked to read a given story and answer the following questions. A qualified professor checked the reading material and the questionnaire to ensure that the contents aligned to measure the participants' memory recall effectively.

2.4 Procedure

The environment was calm, quiet, and free from distractions. Comfortable seating was provided. Participants were informed beforehand about the study's purpose and instructed on what to expect. Upon arrival, drawing numbers randomly assigned participants to one of the two groups (emotionally congruent music and emotionally incongruent music, with no music). This randomization ensures that each participant has an equal chance of being assigned to any of the two conditions, reducing selection bias and ensuring the groups are comparable. A total of 45 participants were assigned to three groups (15 per group).

For the first condition (Emotionally Congruent Music), the facilitator briefly explained the basics of the experiment, and participants were then given instructions. Afterward, the participants were instructed to settle down comfortably as the facilitator handed them a story to read with music that matched the story's mood (happy story + happy music). The same procedure is done in the second condition (Emotionally Incongruent Music), except participants read the story with sad music accompaniment. Lastly, the Control Group (No Music) only involved reading the story without using music). Then, in all conditions, the participants answered an assessment given to them by the facilitators after reading to test how much they could remember from the story.

After the study, participants were debriefed about the nature and purpose of the accompaniment of emotionally congruent and incongruent music and the significance of the findings.

3. RESULTS AND DISCUSSION

A Shapiro-Wilk test was conducted to test the normality of data. For the emotional congruence of music on memory recall, the results show a significant deviation from normality, *W*= 0.874, *P*=<.001. These results suggest that the assumption of normality was violated.

Table 1 Normality Test for Emotional Congruence of Music on Memory Recall

	W	***p***
emotional congruence of music on memory recall	0.874	< .001

Note. A low p-value (p<0.05) suggests a violation of the assumption of normality

Descriptive statistics revealed that the mean quantity of scores in emotionally congruent music was *M*= 8.47 (*SD*= 0.516, *SE*= 0.133.). In contrast, the mean score in emotionally incongruent music was *M*= 8.47 (*SD*= 1.506, *SE*= 0.385.), and the mean quantity of scores in no music was *M*= 7.53 (*SD*= 1.807, *SE*= 0.467). Each condition included N= 15 participants.

Table 2 Memory Recall Scores by Music Condition

			N	Mean	SD	SE
emotional congruence of music on memory recall	emotionally congruent	15	15	8.47	0.516	0.133
	emotionally incongruent		15	8.47	1.506	0.389
	no music		15	7.53	1.807	0.467

This study is conducted to find if music and emotional congruence have a significant effect on memory recall. Kruskal-Wallis, a non-parametric alternative to one-way ANOVA, was utilized to determine the results. The chi-squared *(χ^2)* has a variance of 3.76, derived from the Kruskal-Wallis test, and serves to assess whether significant differences exist in memory recall across different conditions (Emotionally Congruent, Emotionally Incongruent, and No Music). The degrees of freedom *(df)* associated with this test are equivalent to 2. The effect size, measured by eta-squared *(ε)*, was $\varepsilon = 0.0854$. This indicates that approximately 8.54% of the variance in memory retention can be attributed to the emotional congruence of music. The small effect size ($\varepsilon = 0.0854$) further suggests that any observed differences will likely have minimal practical significance. With a *p-value* of 0.153 > 0.05, the findings indicate no significant effect on "memory recall." Thus, we accept the null hypothesis.

Table 3 Kruskal-Wallis Analysis Between Emotional Congruence of Music on Memory Recall

	X^2	*df*	*p*	ε^2
Emotional Congruence of Music on Memory Recall	3.76	2	0.153	0.0854

One study aims to identify how emotionally congruent music influences memory if we compare it to emotionally incongruent music with no music. With condition A being the emotionally congruent condition, participants were exposed to music that aligned with the theme of the reading material, whereas condition B involves emotionally incongruent music. The findings suggest that emotionally congruent music is on par with the mean scores of emotionally incongruent music and slightly better than the no music condition. Music and memory are closely connected because music therapy has become a valuable tool to trigger recall among individuals (Levine, R., 2023). Music, especially when tied to a specific emotion and context, is helpful for learning. In other words, when information is set to a particular music, it becomes easier for individuals to recall concepts and facts (Roberts, C., 2023).

In addition, no significant difference was found in the results of the emotionally incongruent music condition and the non-music condition. Participants in the emotionally incongruent music performed slightly better than those exposed to no music. This result is explained by the notion that music can aid in the recall of memories, even if the music is not

aligned with the theme of the material (Matziorinis, A. M., & Koelsch, S., 2022). However, the Kruskal-Wallis Analysis results imply that the differences between the groups are not statistically significant. One study focusing on emotionally congruent pictures stated that in terms of individual differences, the study's variable was not connected to the emotion-congruency effect. In other words, this fact suggests that mood, gender, music experience, liking, and familiarity have no influence on superior memory for

emotionally congruent over the incongruent condition (Balch WR, Bowman K, Mohler LA., 1992) Moreover, they added that music is not often utilized for mood congruency testing on cognitive functions and, instead, is used more often for music-evoked emotions (Talamini, F., Eller, G., Vigl, J., & Zentner, M., 2022). Music in the study does not significantly influence memory retention, regardless of its emotional congruence. This is affected by the small sample size in the study, and thus, it did not hold statistical power to detect differences in the population.

Several factors, such as the environment of the experiment, and possible exposure of the participant to music before the conduct of the study, how complicated the music-reading task is given to the participants, played a role in its significance (Chitalkina, N., Puurtinen, M., Gruber, H., & Bednarik, R., 2021). The background music in the experiment was not adequately modulated due to the speaker's maximum volume being inadequate to reach all participants. In addition, the environment during the experiment was not ideal. It could have distracted the participants from the task as extraneous variables, including time, ambiance, and temperature during the day, played a part. Hence, these factors played a role in confounding the results.

Furthermore, while music can be beneficial in boosting memory, there are also disadvantages. The findings of another similar study conducted by Jakubowski, K. & Eerola, T. (2021) found that music is not optimal for memory recall cues. Participants who read a story while listening to music, regardless of its theme, become distracted and, therefore, are less likely to remember detailed information (Prabhu, P. S., Nair, R. P., Lau, L. Y., Chong, J. Y., Sia, Z. F., & Aithal, P. A., 2022). This variability of results is explained by multiple factors such as the mood state of an individual, type of task, and style of music as accompaniment in their task. Another study revealed that the effects of music on memorization may vary due to it causing competition in a limited cognitive capacity system (Echaidea, C., del Río, D., &Pacios, J., 2019).

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Conclusion

According to the study, college students' memory recall is not considerably impacted by emotional congruence in music. The presence or absence of emotionally congruent, emotionally incongruent, or no music did not affect participants' recollection of a story they had read. A*p-value*> 0.05 was found in the data analysis, suggesting that the emotional tone of the music had no appreciable impact on memory performance. This implies that the emotional tone of the music did not improve or worsen memory recall in this study.

Nevertheless, several limitations in the study limit how broadly the results may be applied. The study only looked at narrative recall, which might not be relevant to other educational resources. Furthermore, the study solely examined emotional congruence in music, neglecting other elements like tempo, volume, and individual variances in musical tastes or mood, and the sample size might have been too small to identify subtle impacts. Future studies should have a more controlled environment to minimize confounding and extraneous variables. More varied samples examine a broader range of musical qualities and account for potentially confounding factors like mood, personal musical preferences, prior knowledge of participants, and environmental factors to build on these findings. Moreover, the experimental research design utilized in the study has contributed to the general findings, as it only focuses on specific sample sizes. Furthermore, future studies should replicate the research using a correlational design to expand and elaborate the conclusions. Although there was no direct link between emotional congruence and memory recall, these results imply that music's impact on memory might be more nuanced and influenced by various other factors.

Ethical Approval:

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

Consent

Participants were provided with a consent form explaining the purpose of the study, the procedure, and any risks. They were then told to sign the form before participation. For confidentiality, all data were kept confidential and anonymous. Identifying information was not shared. Participation was made voluntary, and participants may withdraw from the study at any time without penalty. After the study, participants were debriefed following the research and given a chance to ask questions. As a form of justice for their participation, the participants were given tokens as a form of appreciation.

Disclaimer (Artificial intelligence)

The Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Acknowledgment

We would like to express our deepest gratitude to all those who have supported and contributed to the completion of this research.

First and foremost, we would like to extend our sincere thanks to our advisor, Miss Claire Lynn B. Culajara, RPm, LPT, MSPsy, RPsy, for their invaluable guidance, insightful feedback, and continuous encouragement throughout this study. Their expertise and unwavering support have played a critical role in shaping this research.

Our heartfelt appreciation goes to our family and friends, for their patience, understanding, and moral support during the course of this research. Their belief in me provided the motivation to push through even the most challenging moments.

Finally, we would like to give thanks to the Almighty Father for their spiritual support, without which this research would not have been possible.

Thank you to everyone who has helped and supported us in any way. Your contributions are deeply appreciated.

REFERENCE

Balch WR, Bowman K, Mohler LA. Music-dependent memory in immediate and delayed word recall. Memory & Cognition. 1992 Jan;20:21-8.

Bower, G. H. (1981). Mood and memory. *American Psychologist, 36*(2), 129–148. https://doi.org/10.1037/0003-066X.36.2.129

Chitalkina, N., Puurtinen, M., Gruber, H., & Bednarik, R. (2021). Handling of incongruences in music notation during singing or playing. International Journal of Music Education, 39(1), 18–38. https://doi.org/10.1177/0255761421991692

Cohen, L., Manion, L., & Morrison, K. (2007). Research methods in education. Routledge.

Echaidea, C., del Río, D., &Pacios, J. (2019). The differential effect of background music on memory for verbal and visuospatial information. The Journal of General Psychology, 146(4), 365-378. https://doi.org/10.1080/00221309.2019.1602023

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). Educational research: An introduction. Longman Publishing.

Jakubowski, K., & Eerola, T. (2021). Emotional reactions to music: The role of individual differences and musical features. *Psychology of Music, 49*(4), 486-502. https://doi.org/10.1177/03057356211014780

Koelsch, S. (2014). Brain correlates of music-evoked emotions. *Nature Reviews Neuroscience, 15*(3), 170-180.

Levine, R. (2023). How music affects memory and concentration. Levine Music. 501(c)(3). EIN: 52-1063325.

Matziorinis, A. M., & Koelsch, S. (2022). The promise of music therapy for Alzheimer's disease: A review. Annals of the New York Academy of Sciences, 1500(1), 47-58. https://doi.org/10.1111/nyas.14864

Naranjo, B., & Rojo López, A. M. (2021). CDC. In and out of tune. The effects of musical (in)congruence on translation.

North, A. C., Sheridan, L. P., & Areni, C. S. (2016). Music congruity affects product memory, perception, and choice. Journal of Retailing, 92, 83–95. https://doi.org/10.1016/j.jretai.2015.06.001

Panteleeva, Y., Courvoisier, D. S., Glowinski, D., Grandjean, D. M., & Ceschi, G. (2022). Effects of emotionally incongruent musical excerpts on memory retrieval. Psychology of Music, 50(3), 945–959. https://doi.org/10.1177/03057356211034571

Prabhu, P. S., Nair, R. P., Lau, L. Y., Chong, J. Y., Sia, Z. F., & Aithal, P. A. (2022). An experimental study on the effect of background music on memory recall among medical students. Journal of Datta Meghe Institute of Medical Sciences University, 17(4), 853–856. https://doi.org/10.4103/jdmimsu.jdmimsu_26_214

Roberts, C. (2023). The correlation between memory and music. Future Care.https://www.futurecaregroup.com/knowledge-hub/memory-and-music

Talamini, F., Eller, G., Vigl, J., & Zentner, M. (2022). Musical emotions affect memory for emotional pictures. Scientific Reports, 12(1), 10636. https://doi.org/10.1038/s41598-022-15032-w