The Melodies of Memory: The Impact of Background Music on Memory and Emotions

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Abstract

The omnipresence of music makes it imperative to study the potential benefits of music for individuals. Thus, this study aimed to investigate the effects of background music on memory and emotion.

A total of 40 high school students from two English classes participated, with each class assigned to either the experimental or control group. Based on previous research, it was hypothesised that participants in the experimental group, who would watch a video with background music, would perform better on a content questionnaire compared to the control group, who watched the same video without music. Additionally, the study aimed to examine whether music could elicit different emotional responses.

The research followed a quasi-experimental design, including a pre-test, intervention, and post-test approach. The participants answered one questionnaire containing the PANAS scale prior to watching the video to measure their emotional state. They then viewed the assigned video, which was followed by a post-test questionnaire that contained the PANAS scale again, a content questionnaire about the video and the video engagement scale.

The results did not yield significant findings for either hypothesis. As a result, this study contributes to the development of innovative and sustainable approaches to memory enhancement by outlining which elements are essential for learning materials and how music can be integrated into them.

1. Introduction

New learning materials are required to meet the needs of modern and digitalised generations. This shift in learning methods aligns with the evolving lifestyle that predominantly involves video consumption (Liu-Thompkins & Rogerson, 2012). Consequently, research began to focus on the usage of videos in all kinds of life settings, including academic environments (e.g., Çeken & Taşkın, 2022; Furnham & Bradley, 1997; Königschulte, 2015).

Video-based learning is a broad topic that consists of a variety of elements. Therefore, it is crucial to differentiate and analyse specific ones. One element of videos is the background music. Kuo and colleagues (2013) mention that the type of background music that is chosen for videos is the key element to making the video attractive to the audience. Background music in videos is considered a secondary activity (F. Scherer, 2006). Secondary activity, in this case, refers to the usage of music in the background while primarily conducting other tasks, such as viewing the video. Background music, however, can be used in a variety of ways.

1.1 Music as a Tool

As mentioned before, background music can be used in multiple ways. Firstly, music can help individuals to memorise information better because the brain is used in a more efficient way (mnemonic enhancer) (Knott & Thaut, 2018). Secondly, music can impact the emotional state of individuals and can create a state in which the individual is more focused and susceptible to learning (Hallam et al., 2002). Overall, music can, therefore, be used as a tool that helps to create a desired outcome. Firstly, the study will focus on music as a mnemonic enhancer. Mnemonic enhancer, in this case, means that music assists people in retaining information more effectively because it functions as an aid to memory retention (Knott & Thaut, 2018).

1.1.2 Music as a Mnemonic Enhancer

"Son, can you play me a memory" (*Billy Joel – Piano Man*, n.d.) was once sung by Billy Joel in his 1973 published song Piano Man. The song Piano Man by Billy Joel is widely recognised and often prompts the audience to sing along. Beneath the surface, however, lies a subtle message indicating the importance of music. Specifically, the song raises the question concerning the potential correlation between music and memory. Is it plausible that music possesses the capacity to impact memory in a manner consistent with the way it was expressed in the lyrics? In essence, the song invited exploration into the proposition of whether music can function as a mnemonic enhancer. To put it short: Can music serve as a mnemonic enhancer for the brain to recollect information (i.e., 'play a memory')?

On the one hand, it can be expected that background music can support learning performance and memory. Murakami (2017) points out that the rhythm of a melody can transfer verbal information (spoken words accompanied by music or sung words within music) into working memory, and thus the information is processed faster and more sustainably. Background music can, therefore, enhance memory, and information is learned faster with background music than without (Murakami, 2017). Further, background music can directly stimulate pre-existing cognitive frameworks (schemes) in the human brain and is more effective for capturing attention compared to visual stimuli (Königschulte, 2015). This can be clarified by the fact that background music functions as a different medium than images and video material when it comes to presenting the information (Königschulte, 2015). According to Königschulte, this phenomenon can be attributed to its inherent characteristics as humans are unable to voluntarily stop auditory perception, unlike visual perception (closing the eyes). Consequently, the auditory sense is less constrained than the visual sense, and it can process information faster (Königschule, 2015). This means that background music can enhance the likelihood of creating schemes or evoking already existing schemes, which

can enhance the memory retention process because individuals are more engaged with the schemes, they are already familiar with (Königschulte, 2015). Consequently, the presence of background music leads to increased engagement, which enhances memory.

On the other hand, it can be expected that background music can hinder learning. A study by Furnham and Bradley (1997) investigated whether pop background music distracts participants while performing cognitive tests such as reading comprehension and memory tests (Furnham & Bradley, 1997). They concluded that participants who listened to pop music performed significantly worse compared to the control group. This shows that listening to pop background music while performing tasks might be disruptive to learning performance (Furnham & Bradley, 1997).

Accordingly, the effects of background music on learning performance can be viewed from two perspectives: hindering and enhancing. These seemingly contradictory claims can coexist within the framework of multimedia learning principles. Multimedia learning principles are derived from cognitive science and instructional design to create multimedia materials, in this case, videos, more effectively for learners (Çeken & Taşkın, 2022).

From the hindering perspective, background music can potentially hinder learning success by increasing cognitive load (Königschulte, 2015). When the music is loud, distracting, or unrelated to the learning content, it distracts learners' attention and interferes with their ability to process information faster (Moreno & Mayer, 2000). As a result, it aligns with cognitive load theory, as well as redundancy and coherence principles that emphasise minimising cognitive load by managing irrelevant information (Moreno & Mayer, 2000). This means that background music is an irrelevant addition to multimedia content that possibly distracts individuals from the original content of the material (Königschulte, 2015).

However, from an enhancing perspective, background music can contribute to learning success by influencing learners' emotional state and engagement. It has been proven

that music that is appropriate in tempo and mood improves motivation, reduces anxiety, and fosters a positive emotional experience during learning (Kang & Williamson, 2014). As a result, learning experiences will be engaging and emotionally relevant, aligning with personalisation and signalling principles (Moreno & Mayer, 2000).

Hence, multimedia principles allow for a more nuanced approach to the use of background music in education and can help strike a balance between the claims regarding how it impacts learning performance (Mayer & Fiorella, 2014). This nuanced approach is supported by a study conducted by Kang and Williamson (2014), which examined the effect of background music on learning. In their research, two groups were created, with participants divided into groups that either received learning materials accompanied by background music or without (Kang & Williamson, 2014). Their findings revealed that the type of background music to which participants were exposed played a crucial role in determining the impact on learning performance (Kang & Williamson, 2014). Specifically, the study demonstrated that background music with a low level of complexity enhances learning abilities, while background music with a high level of complexity hinders it. Complexity, in this context, refers to the number of elements included in a melody, such as tempo, sound, and vocals. The greater the number of elements, the more complex the music becomes (Kang & Williamson, 2014). Consequently, Kang and Williamson (2014) concluded that background music can hinder learning acquisition, but it can also facilitate it. The outcome is highly dependent on factors such as tempo, genre, and the overall characteristics of the music employed (Kang & Williamson, 2014).

1.1.3 Music as a Tool to Influence Emotions

Background music has a significant impact on individuals' emotional states, fostering an environment that promotes increased concentration and receptivity to learning. The multimedia principles indicate that background music has the potential to enhance learning

success through its impact on arousal and emotional engagement (Knörzer et al., 2016). Therefore, the creation of emotions is the second way of using background music as a tool.

In Piano Man, Billy Joel continues to sing, "It's sad, it's sweet (...), and you have got us feeling all right." (Billy Joel – Piano Man, n.d.). This interpretation implies that music can be described through the use of emotions, such as sadness. Furthermore, he discusses the benefits that listening to music can provide to individuals, such as the feeling of "alrightness". These ideas raise the question of whether music can actually impact people's emotional responses. Can music truly have the power to make individuals "feel alight"? Emotions are a concept that possesses a variety of definitions. In this study, emotions are defined as conscious and subjective mental reactions, encompassing powerful feelings like anger or fear (Emotions, n.d.). They are typically directed towards a particular object or situation and come with noticeable changes in the body's physiology and behaviour (Emotions, n.d.).

The collective body of research provides compelling evidence supporting the notion that music can effectively enhance learning performance through its influence on individuals' emotional states (Jäncke, 2008). Findings from one study indicate that music can evoke diverse emotions, including motivation, and relaxation (Jäncke, 2008). These emotions, in turn, exert a significant influence on learning performance. When individuals experience positive emotions evoked by music, they demonstrate heightened engagement, attentiveness, and receptivity to learning materials (Hallam et al., 2002). This emotional engagement, in turn, enhances information processing, memory retention, and overall cognitive functioning.

Furthermore, research shows that background music leads to better memory retention through increased emotional arousal (Jäncke, 2008). Neuroscientists explain this phenomenon using oscillations (Bever, 1988). An oscillation is a recurring pattern of movements or fluctuations that occur periodically. According to them, oscillations can arouse

people by affecting their neurophysiology (Bever, 1988). It is believed that attentional oscillations occur during the processing of serial stimuli while accessing internal knowledge and simultaneously recording external input. In this case, background music functions as external input and the association with past experiences as internal knowledge (Bever, 1988). Those results indicate that background music modulates physiological responses, such as heart rate, blood pressure, and stress levels, thereby contributing to an optimal learning state. By cultivating a positive emotional climate and reducing stress and anxiety, music creates an environment for effective learning and knowledge acquisition (Bever, 1988).

Furthermore, it has been argued that music, as a variable in itself, cannot generate emotion directly since no explicit event takes place (Bever, 1988). Therefore, emotions arise solely from what individuals associate with music and how much they engage with it. It is also possible for the same song to evoke the same emotions repeatedly (Bever, 1988). Studies have shown, however, that the same song can evoke other emotions as well. Accordingly, music does not create new emotions in people but rather unlocks private emotions that individuals already possess (Bever, 1988).

When studying the analysis of emotions in music, the term "engagement" is frequently used. Engagement is, therefore, an important factor to consider when examining the impact of music on emotions (Croom, 2014). Engagement is often used to explain why music affects emotions. The existing body of research asserts that music enhances engagement by enabling individuals to connect with the content on a personal level, which, in turn, influences their emotional state (Croom, 2014). Consequently, engagement is a crucial confounding variable that requires control in studies.

Therefore, existing research does not show a clear picture of whether music itself can influence the emotional state of individuals or whether the emotional state influences how music is perceived. Hence, researchers concluded that it is essential to track the emotions of

participants before the experiment to ensure reliability (Scherer, 2004). In conclusion, the theoretical framework shows that music is often used in education and that it is a popular addition to video creation. However, research has been inconclusive about the effect of background music on memory and emotions. Therefore, it is crucial to investigate the topic further.

1.2 Current study

Studies provide evidence that emotions and memory are crucial elements in multimedia learning and that background music might enhance learning performance. However, the results of the studies are inconclusive and indicate no direct indication of whether background music affects memory and emotions. Especially relevant are the multimedia principles. Although the coherence principle advocates minimising irrelevant elements, like background music, the principles of personalisation and modality emphasise the benefits of incorporating background music into videos. Through this addition, information is presented through a variety of sensory channels and creates a sense of emotional engagement (Knörzer et al., 2016). This shows that multimedia principles do not provide an answer to whether background music is a suitable addition to multimedia learning videos since principles provide contradictory results. Therefore, it is critical to conduct further research on the topic to determine whether background music can affect memory and emotions as a tool.

Based on the previous research that highlighted the importance of emotions and memory in multimedia learning, emotions and memory has been determined as the two core concepts of this study. Moreover, the variable engagement was controlled in this study as well. In light of these factors, this paper aims to answer the following research question: *To what extent does adding background music to multimedia learning videos benefit memory and influence emotions?* In this paper, memory and learning performance are used

interchangeably, and both represent the same concept.

The given framework of research suggests that background music positively impacts the learning performance of participants (Hypothesis [1]), and it is expected that background music can change the emotional state of participants (Hypothesis [2])

The paper will begin by examining how the experiment was conducted, in which two high school classes viewed a video that either contained background music or not and answered two questionnaires containing the positive and negative affect schedule and a content question. Afterwards, the results of this study will be described. Following that, the results will be discussed.

2. Methods

2.1 Design and Participants

The study has been approved by the University of Twente Ethics Committee (no.230647). The aim of this study is to examine whether adding background music to a video about peer pressure has a positive effect on the learning performance of participants.

The participants of this study were composed of two high school English classes from two different German high schools. Each class represented one group. The sample for each group was composed of 20 participants resulting in a total of 40 participants for the whole study. The participants were selected using a nonprobability sampling technique; samples of this type are referred to as convenience samples since they were chosen based on their accessibility. The average age of the participants was 18.65 (sd = 8.60; min = 16, max = 56) for the control and 16.95 (sd = 0.87; min = 16, max = 18) for the experimental group. Prior to the study, all participants or their spokespersons consented to participate in the study. Table 1 provides a more distinct overview of the demographic data per group. However, one participant that took part in this study was outside the originally planned sample. One of the teachers in the control group participated as well, hence why one of the participants is 56 of

age. It was checked whether her results differed greatly from the ones of the students to ensure reliability, and no difference was found. Therefore, it was decided to keep her in the sample.

Since the participants were German students in an English course, they had to indicate their English level. This was self-assessed, meaning that the students had to indicate their English knowledge according to their perception. For this, a question was used in which participants were asked how they would describe their English knowledge ranging between (1) Beginner, (2) Average, (3) Fluent or (4) Mother Tongue. The reason for this is that the data is highly protected in Germany, meaning that the school is incapable of providing a different form of assessment. In order to prevent legal issues, the self-assessment was chosen.

This study was conducted as a quasi-experimental study with two groups (experimental and control) following a pre-test – intervention – post-test design. In the course of this, two videos were created (Appendix B). The experimental group were instructed to watch a video that included background music, while the control group received a video without. The participants were assigned to one group.

Table 1

Demographic Data

	Control Group		Experimental Group	
Characteristic	n = 20	%	n = 20	%
Gender				
Men	5	25	4	20
Women	14	70	15	75
Other	1	5	1	5
Nationality				

German	17	85	13	65
Other	3	15	7	35
Education				
Q1*	19	95	20	100
Graduate	1	5	-	-
English Level				
Average	7	35	6	30
Fluent	13	65	12	60
Mother tongue	-	-	2	10

Note: Q1 refers to qualification phase 1 in German Highschool, which is the equivalent of either the 11th or the 12th grade, dependent on the high school form.

2.2 Materials

In this study, two types of materials were used. One being the measurements and the other being the intervention. Firstly, the intervention will be discussed, followed by the measurements.

2.2.1 Intervention

All students worked with the same material in each group. Firstly, a consent form was used that was handed out to students before the experiment (Appendix A). The first materials that were created were two videos about the topic of peer pressure. The videos were 5 minutes and 12 seconds each. In the video, the protagonist gave examples of peer pressure, and they defined it in detail (Appendix B). However, two versions of the same video were created. One of the videos contained background music and sound effects like heartbeats, while the other video did not. Firstly, the videos were cut in a cutting programme, namely Davinci Resolve 18, and background music and sound effects were added through Epedemic Sound.

2.2.2 Measurements: *First Questionnaire*

Afterwards, two questionnaires were created through the online website Qualtrics. The first questionnaire (pretest design) contained multiple elements and was administered before viewing the video. Firstly, a second consent form consisting of three questions (Appendix C). Secondly, it contained five questions regarding demographic data, such as "Please indicate your age in numbers" (Appendix D). Lastly, it included The Brief Measure of Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). The PANAS (Positive and Negative Affect Schedule) test assesses an individual's positive and negative emotional states using a twenty-item scale (Appendix E). One example item for positive items is "interested", and one example of negative items is "distressed". The evaluation of the test results involves comparing individual results with the average scores of a comparison group. In this case, the differences between the experimental group and the control group were highlighted. The scales of the PANAS test range from 1 (very slightly or not at all) to 5 (Extremely). Consequently, the PANAS-Test can result in individual scores between 10 and 50. A higher total score indicates a positive effect, while a lower total score indicates a lower negative effect. Interpretation, however, of the results is typically made individually. Therefore, it is not possible to make a general statement about at what score the results would be considered significant. The calculations were carried out in accordance with Watson and Colleagues' guidelines (Watson et al., 1988). As indicated by Watson and colleagues (1988), the PANAS scale shows a high internal consistency for positive affect ($\alpha = .79$) and for negative affect ($\alpha = .81$) and is proven to be a suitable measure. In this study, it resulted in a high internal consistency as well. To be more concrete, it resulted in an internal consistency of $\alpha = .90$ for positive affect and of $\alpha = .91$ for negative affect. To analyse the data set, firstly, dummy variables were created for the 5-point Likert scale. With such dummy variables, the total scores for all individual participants were calculated with R-Studio and

added to the data frame.

2.2.3 Measurements: Second Questionnaire

The second questionnaire (post-test design) was undertaken after viewing the video and it contained three elements. Firstly, the Positive and Negative Affect Schedule. Secondly, the Video Engagement Scale (VES) (Visser, 2016). The Video Engagement scale, short VES, was used in the study to measure students' engagement with the presented video (Appendix F). The Video Engagement scale is a self-report measure developed by Visser (2016) and consists of 15 items, which are divided into five dimensions of video engagement, with three items representing each dimension ($\alpha > .86$). These dimensions include emotions, empathy, identity, attention, and immersion into a narrative world. Visser, however, concluded that each dimension could also be used separately. In accordance with his statement, the study relied solely on the dimension "Attention". Therefore, only the three items that pertain to attention were considered. To assess attentional video engagement, participants were asked to rate their level of agreement on a 7-point Likert scale, ranging from "1 = completely disagree'' to '7 = completely agree", in response to the following statements:

1. "During viewing, I was fully concentrated on the video."

2. "When I was viewing the video, my thoughts were solely focused on the video."

3. "During viewing, I was barely aware of my surroundings."

The video engagement scale represents a high internal consistency with a Cronbach's alpha of $\alpha = .95$ in this study. The VES was used to control the possible confounding variable of engagement and attention.

Thirdly, the second questionnaire included 13 multiple-choice questions about the content of the video, such as “What does the first sequence of the video focus on?”. It can

also be referred to as a content knowledge questionnaire (Appendix G). Participants were given four answer possibilities, out of which one was correct. In addition, a PowerPoint presentation (Appendix H) was created containing information about the researcher and the study itself. Furthermore, it also included QR Codes that lead to the questionnaires. The questionnaire shows a high internal consistency of the Cronbach's alpha ($\alpha = .94$) in this study.

2.3 Procedure

There were two classes, one class per condition. The experiment was carried out in one session of 30-minute duration. The classes participated on different days. Throughout the whole experiment, the students were sitting at their assigned seats in the classroom, and the researcher was standing at the front of the room. The study started with an introduction of the researcher and by giving a presentation (Appendix H) about the following course of action. In both conditions, a screen was present at the front of the classroom, which first showed the presentation. Following the introduction, the students scanned the given QR codes and answered the first questionnaire individually on their personal devices. Afterwards, the researcher presented a video of approximately five minutes (either the control or the experimental condition) on the front screen. This video was watched with the whole class and not individually. Afterwards, the students had to scan a second QR code which guided them to a second questionnaire containing the content knowledge questionnaire.

2.4 Data Analysis

The data analysis was conducted using version 2023.03.0+386 of RStudio. The analysis of this thesis can be divided into three phases. In the first phase, the data of the content questionnaire was analysed. In the second phase, the PANAS test was further evaluated, and lastly, the results of the VES were scrutinised.

The first phase focuses on the dataset of the content questionnaire. Firstly, the data file

was checked for missing data and whether all participants answered all questions. Secondly, answers were coded. The right answers as 1, the wrong answers as 0 and the sum scores were calculated. Furthermore, the dataset of the control condition and the experimental condition were assembled for further analysis in one data frame containing the total scores of all individuals.

Furthermore, a Shapiro-Wilk normality test was conducted with the aim of testing whether the underlying population of the sample is normally distributed. It resulted in a score of $W = 0.76$, $p = < .001$, which is significant and indicates that the data is not normally distributed. The Wilcoxon rank sum test with continuity correlation was used in the composed dataset to determine whether the hypothesis that background music has a positive effect on the learning outcome of participants could be accepted or rejected. The test operates under the assumption that the data is not normally distributed, which makes it suitable for the given dataset. Moreover, the Wilcoxon rank sum test was modified in R Studio so that the p-value is based on the hypothesis that the experimental group will perform better in a given test than the control group and not only on the perceived differences between groups. Therefore, for the first hypothesis, a non-parametric test was used.

The second phase of the data analysis puts great emphasis on the second hypothesis by evaluating the PANAS scale. For the analysis of the PANAS scale, four datasets were used, two per condition. Each dataset represented the conducted data before and after the experiment. One dataset for the positive scores and one for the negative ones. All datasets were handled identically. Subsequently, descriptive data were evaluated in order to calculate the mean value of all participants per condition and to create comparative data. Furthermore, a Welch two-sample t-test was conducted to evaluate significant differences between the conditions in the composed dataset.

The third phase focused on the calculation of the video engagement scales (VES).

Firstly, the data set containing three items was scrutinised. Secondly, the total scores per participant were calculated. Followed by an analysis of the mean scores per condition. Moreover, a Welch two-sample t-test was conducted to determine a significant difference between the groups.

3. Results

The following section presents the results of the study, which aimed to answer the research question of whether background music benefits memory and whether it influences emotions. For that, two hypotheses were created. The data was collected through pre-intervention- post-design administered to a sample of 40 participants. The findings presented provide insight into how background music affects individuals, and they address the hypotheses mentioned above.

Table 2

Descriptive Statistics of the Control Group and the Experimental Group

Characteristic	Control Group		Experimental Group	
	M	*SD*	*M*	*SD*
Content Questionnaire	8.7	4.35	9.5	2.95
PANAS Scales				
Positive Score Before	27.15	9.4	26	12
Positive Score After	27.65	9.4	26	13
Negative Score Before	21.55	10	15.9	7.7
Negative Score After	20.05	10	17	9.6
VES	13.30	5	14.4	4

3.1 Hypothesis One: Background music positively impacts learning performance.

The first hypothesis proposed that background music would have a positive effect

on learning performance. To test this hypothesis, a Wilcoxon rank sum test with continuity correction was conducted to compare learning performance between the control group and the experimental group. The test resulted in a non-significant result, with W = 195 and p = 0.45, indicating that there was no significant difference in learning performance between the two groups.

Additionally, learning performance was assessed by examining the mean scores for correct answers (Table 2). The control group had a mean of 8.7 (SD = 4.35) for correct answers, while the experimental group had a slightly higher mean of 9.5 (SD = 2.95). In spite of this, the difference in means did not reach a statistically significant level. This study found that background music did not significantly contribute to positive learning performance.

3.2 Hypothesis Two: Background music can change the emotional state of participants.

The second research hypothesis stated that background music would have an effect on participants' emotional state. This study employed the Positive and Negative Affect Schedule (PANAS) to assess participants' emotional state. The PANAS scale measures positive affect (PA) and negative affect (NA). A descriptive analysis was conducted for both the experimental group and the control group in relation to their PANAS scores before and after watching the video (Table 2).

To determine if there was a significant difference in the emotional state between the experimental group and the control group, a Welch's two-sample t-test was conducted. The test revealed a non-significant result, t (237.39) = -.108 p = 0.914. Thus, there was no statistically significant difference in emotional state between the two groups. These findings suggest that background music did not have a significant effect on the emotional state of participants as measured by the PANAS scale.

3.3 Control Variable: Engagement

Thirdly, the possible confounding variable was controlled by incorporating the video

engagement scale into the data analysis. In order to analyse the results, a Welch's two-sample t-test was conducted. The video engagement scale resulted in a p-value of t = .868, p = .391. The results showed no significant difference between the two groups. Showing that engagement was not affected by background music.

4. Discussion

4.1 Main Findings

The primary objective of this study was to explore the extent to which the inclusion of music in storytelling videos benefits memory. Additionally, this study placed considerable importance on investigating the influence of music on the emotional well-being of participants. Taking this concept into account, it was hypothesised that music might change the emotions of participants. However, the results of this study indicate a lack of statistically significant effects on the impact of music on learning performance and emotional state among the participants.

Firstly, the study aimed to investigate the hypothesis that "*Background music positively impacts learning performance*." However, the findings revealed no significant difference in the performance of the groups, as both groups performed equally well in answering the questions correctly. Thus, it can be concluded that the presence of background music did not influence the learning performance of the participants in this study.

These results align with a similar study conducted by Königschulte (2015), which explored participants' performance in tasks while listening to music. Even though Königschulte's study was not focused on academic tasks, no significant differences were found either. The results support the notion that background music has no impact on performance.

A study by Kumar and colleagues (2016) reported contradictory results, indicating that listening to music enhances learning. As an example, Kumar et al. (2016) examined how

music affects students' academic success and concentration by analysing their responses to a questionnaire while listening to music individually over headphones. The participants in the current study, however, did not directly engage with music since they were not required to listen to it individually. Instead, they watched a video that either contained background music or did not, with the entire class. The background music used in this study was designed to be subconsciously perceived and subliminally understood, rather than aiming at direct engagement with the participants. Direct engagement refers to the fact that participants listened to background music consciously since they actively put headphones on, knowing that music is about to be played. As a result, the current study differs significantly from Kumar et al. (2016), since their study involved participants listening directly and consciously to music.

Secondly, the hypothesis suggesting that *"Background music has an effect on the emotional state of participants"* can also be rejected. The results indicated that the video containing background music did not lead to any significant changes in the items related to positive emotions, nor in the items associated with negative emotions. Moreover, the results of the video engagement scale showed no significant differences between the groups, which shows that the video containing background music did not increase engagement and attention. This can be explained by the fact that both groups found themselves in a similar environment. It could be that not the video itself influenced the emotional state but, instead, the surrounding environment. The students were located in their high school in an academic setting which could have influenced how they felt before they watched the video and afterwards. A study proved that students' emotional well-being changes before they conduct a task and after they finish it (Govorova et al., 2020). It could have been that in both settings, the set of students involved might have seen the experiment as another

academic task hence, why the emotional state of both groups did not change significantly (Govorova et al., 2020).

4.2 Implications

In the present study, two high school classes were used to investigate whether background music impacts memory. Neither the group watching a video with background music nor the group watching a video without background music significantly differed in their performance. There are several implications for understanding the effects of background music on memory from these findings.

In the first place, the non-significant differences in performance between the two groups challenge the widely held belief that background music benefits memory. In particular, it challenges previous research on the topic that suggested that background music could benefit memory. Therefore, this study adds to the understanding of how background music affects learning performance. In addition, it contributes to the discussion about what multimedia learning content is needed to meet students' needs. There might not be a need for background music in videos to achieve positive learning performances for students, according to this study. This knowledge can therefore serve as a basis for future multimedia content.

Secondly, the non-significant results highlight the need to take into account individual differences when studying the effects of background music on memory. This is relevant since not everybody prefers to listen to background music while others might learn better with background music, and the non-significant results showcase that there might be other variables that need to be taken into account. The results give room to explore further influences that might benefit memory instead of background music. The effectiveness of background music on memory may be influenced by factors such as individual learning styles, personal preferences, and the preferred learning environment. The interaction between

these factors and background music could be explored more deeply in future research.

Thirdly, the study was conducted with high school students in a classroom setting. This environment makes the study relevant to an educational context. By examining the effects of background music on memory in a setting familiar to students, the findings may have practical implications for teachers and students seeking effective memory-enhancing material. By understanding how students learn best, teachers can design instructions that encourage student engagement and achievement. Thus, it is important to conduct research in line with ongoing trends that maximise students' interest in learning, such as the use of video material. It is important that teachers engage with innovative methods to enhance students' success since research has shown that when students experience academic achievement, they also tend to enjoy the learning process more (Valiente et al., 2012). Therefore, the knowledge derived from this paper demonstrates that background music is not a necessity when it comes to its functioning as a mnemonic enhancer for students. This supports the existing body of research to develop innovative and modern learning materials for students. The results of this paper provide further insight into whether background music can benefit memory in multimedia learning content.

By recognising the limited impact of background music on memory in this study, teachers can consider alternative approaches and strategies to enhance students' learning experiences. This may involve exploring other instructional techniques or adopting multimedia materials that prioritise other elements instead of background music, such as the relevant content itself.

4.3 Limitations

The results of this study provide valuable insights. It is, however, important to also acknowledge the study's limitations when interpreting the results.

First of all, the small sample size is a limitation of this study. The experiments were conducted with two high school classes which limits the generalizability of the results. A larger sample size might provide a more accurate picture of the population as a whole. Therefore, future research should include a larger sample size that includes participants from diverse backgrounds to make the findings representative and increase the statistical significance of the study.

Secondly, personal preferences were not considered in the study. The study involved high school students since this demographic is relevant in the context of learning performance. However, it is crucial to consider individual preferences in learning style, music taste, and video content (Hallam et al., 2002). Those attributes could have influenced the study's outcome since some students might find it easier to study with video content; some students prefer to listen to music while studying, while others do not. It can be hypothesised that students that prefer to study with video material and with background music might had an advantage in this study over those that, for instance, prefer to read study material. Some students might prefer slow music with a subtle melody, while others prefer techno music while studying. Therefore, future research should explore the effects of background music on memory in different age groups or populations to understand potential differences. It would also be beneficial to conduct future research on the topic to scrutinise whether personal preferences matter in the context of whether music benefits memory.

Additionally, the type of background music chosen could have influenced the results as well. The purpose of this study was not to examine the specific characteristics of the background music in the video (Hallam et al., 2002). However, there is a possibility that different genres, tempos, or melodies can have different effects on memory (Kang & Williamson, 2014). In order to analyse whether background music has an effect on learning performance, it is crucial to focus on different genres and forms of music. Therefore, future

research should be conducted in which multiple types of background music are used, for instance, music containing vocals. This way, it is possible to determine which type of music might increase learning success and which music might be counteracting such an effect.

Lastly, the classroom setting could have been a limitation as well. It was observed that participants engaged in conversations while completing the questionnaires. This could lead to collaborative responses to the questionnaire. This raises concerns about the validity of individual answers and the potential of bias if participants worked together on the questionnaires instead of alone as anticipated. Therefore, it is crucial to acknowledge the presence of distractions and environmental factors within the classroom setting that may have influenced participants' memory performance. Future research should consider conducting experiments individually to limit the potential of group work. Alternatively, future research can explore the topic in a controlled laboratory setting to limit potential confounding variables.

5. Conclusion

The results of this study suggest that background music had no significant effect on the memory performance or emotional state of participants. As a result of these findings, we gain a deeper understanding of the role of background music in memory enhancement, as well as the importance of considering a variety of factors, such as engagement. Nonetheless, future research is required to explore further the potential influences of different music genres, a more diverse age group and a controlled experimental setting on memory. Nonetheless, teachers and other researchers can use this study's insights to create sustainable multimedia learning materials that maximise students' memory performance.

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Appendix

Appendix A

Consent Form on paper

University of Twente
Enschede, The Netherlands

Psychology Department

Participant Consent Form

Purpose:
The purpose of this study is to examine whether videos benefit the memory of students and whether it might help students gain more learning success. The study is part of Paula Sinoradzki's Bachelor thesis in educational psychology under the supervision of Assistant Professor Judith ter Vrugte.

Procedure:
If you agree to be in this study, you will be asked to do the following:

1. Watch a video of approximately five minutes.
2. Report your emotional state prior to and after watching the video.
3. Complete a questionnaire containing 13 questions about the video.

The total time required to complete the study should be approximately 25 minutes.

Benefits/Risks to Participant:
Participants will learn about a psychological phenomenon and broaden their knowledge. There is no direct risk for the participants, and no personal questions will be asked. Each participant will be given a random number, and no names will be used in the study.

Voluntary Nature of the Study/Confidentiality:
Your participation in this study is entirely voluntary, and you may refuse to complete the study at any point during the experiment, or refuse to answer any questions with which you are uncomfortable. You may also stop at any time and ask the researcher any questions you may have. Your name will never be connected to your results or to your responses on the questionnaires; instead, a number will be used for identification purposes. Information that would make it possible to identify you or any other participant will never be included in any sort of report. The data will be accessible only to those working on the project.

Contacts and Questions:
At this time, you may ask any questions you may have regarding this study. If you have questions later, you may contact me, Paula Sinoradzki, at p.sinoradzki@student.uwtente.nl.

Results:
If you are interested in receiving the results, you can contact me at the following E-Mail address:
p.sinoradzki@student.utwente.nl

Statement of Consent:
I have read the above information. I have asked any questions I had regarding the experimental procedure, and they have been answered to my satisfaction. I consent to participate in this study/ I consent that the child I am a legal guardian of is allowed to participate in this study conducted by Paula Sinoradzki.

Name of Participant_____Date: _____

Signature of Participant or the legal guardian _____

Age: _____

Thanks for your participation!

Appendix B

Screenshot of the Video

Appendix C

Second Consent Form in the online questionnaire

I consent taking part in this study

- I give my consent
- I do not give my consent

I am aware that I can withdraw from this study

- Yes
- No

I am aware that my data will be handled anonymously and confidentially

- Yes
- No

Appendix D

Demographic Data

Gender

- Male
- Female
- Non-binary/ third gender
- I prefer not to share

Please indicate your nationality

- German
- Dutch
- Other

Please indicate your age in numbers

Appendix E

PANAS Scale

	Very slightly or not at all	A little	Moderatley	Quite a bit	Extremely
Interested	○	○	○	○	○
Distressed	○	○	○	○	○
Excited	○	○	○	○	○
Upset	○	○	○	○	○
Strong	○	○	○	○	○
Guilty	○	○	○	○	○
Scared	○	○	○	○	○
Hostile (feindlich)	○	○	○	○	○
Enthusiastic	○	○	○	○	○
Proud	○	○	○	○	○
Irritable	○	○	○	○	○
Alert	○	○	○	○	○
Ashamed	○	○	○	○	○
Inspired	○	○	○	○	○
Nervous	○	○	○	○	○
Determined (entschlossen)	○	○	○	○	○
Attentive	○	○	○	○	○
Jittery (rappelig)	○	○	○	○	○
Active	○	○	○	○	○
Afraid	○	○	○	○	○

Appendix F

VES- Attention Items

Video Engagement Scale (VES)

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
While watching I was completely focused on the video	○	○	○	○	○	○	○
While watching, I felt like I was present at the events in the video	○	○	○	○	○	○	○
While watching the video, I was fully concentrated on it	○	○	○	○	○	○	○
After the video ended, I felt as if I was coming back into the "real" world	○	○	○	○	○	○	○
When I was watching the video, in my imagination I was in the world of the video	○	○	○	○	○	○	○
While watching, I was hardly aware of my surroundings	○	○	○	○	○	○	○

Appendix G

Example items of the Content Questionnaire

On which exact term is the video focused on?

- Group Pressure
- Peer Pressure
- Social Pressure
- Society Pressure

Who experiences peer pressure?

- Children from the age of 2 until 10
- Teenagers and young adults
- Seniors
- People of all ages

Which actor was pressured into not wearing a mask?

- Ben Stiller
- Adam Sandler
- Tom Holland
- Brad Pitt

Appendix H

Example slide of the Presentation