

# Effects of Happy and Sad Music in Relation to Different Genres on Mind-wandering: A Replication Study of Taruffi et al. (2017)

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## ABSTRACT

The aim of the study was to replicate the effects of different emotions of musical stimuli on mind-wandering investigated by Taruffi et al. (2017). This study also expands this investigation to look at the effects of different musical genres (opera, rock and folk) and the difference between musicians and non-musicians on mind-wandering. Participants were required to complete an online survey whereby they were asked to self-report how focused they were after each musical stimulus on a scale of 1-7 and then provide a more in-depth answer as to what they were thinking about if they scored  $>3$ . It was found that participants self-reported higher levels of mind-wandering when listening to sad music compared with happy music, as found in the original study. It was also found that the difference in mind-wandering between genres (with opera being the highest, followed by folk and then rock) was more significant than the difference in mind-wandering between musicians and non-musicians, with musicians self-reporting marginally higher levels of mind-wandering overall compared to non-musicians. The results can be explained in terms of individual familiarity of genre, as well as variables such as the tempo of the audio stimuli.

## 1. INTRODUCTION

Mind-wandering has been defined as ‘a situation in which executive control shifts away from a primary task to the processing of personal goals’ (Smallwood & Schooler, 2006). Mind-wandering is also regarded as ‘a shift in the contents of thought away from an ongoing task and/or from events in the external environment’ (Smallwood, 2014). Research in regard to mind-wandering has shown that not only does mind-wandering occur frequently (in 46.9% of the samples collected) but also that people were less happy when their minds were wandering than when they were not (Killingsworth & Gilbert, 2010). This shows that mind-wandering significantly affects people in their everyday lives, and that it is a worthy topic of investigation into how this cognitive process works and if research can help people in decreasing mind-wandering levels and therefore increasing productivity and general mood.

The relationship between music and emotion is something that has been widely researched, for example looking at research which suggests that the presence of lyrics in happy music induces weaker positive emotions compared with happy music without lyrics (Brattico et al., 2011). However, the relationship between music and mind-wandering has not been investigated as extensively, and yet remains crucially important in this area of research.

An issue that can be found with studies investigating mind-wandering is that when asked about one’s mind-wandering state, this may have affected the participant’s mental state for the rest of the survey as they may have been constantly thinking about mind-wandering itself. In the study *Are you mind-wandering, or is your mind on task? The effect of probe framing on mind-wandering reports* (Weinstein, de Lima & van der Zee, 2017), they examined the effect of stopping participants in a task to ask about their current thought state. They did this by asking one group specifically about mind-wandering and the other group if they were “on task” or not. When using the wording “on task”, mind-wandering reports were lower compared to when participants were asked about their thought state using the mind-wandering framing. This suggests that the probe framing within experimental tasks can affect the levels of mind-wandering itself. This study explained this through the concept that those who are specifically asked about mind-wandering may think that it is more acceptable to not pay as close attention to the task and that mind-wandering was expected of them by the researchers.

Taruffi et al. (2017) investigated the effects of sad and happy music on mind-wandering in Experiment 1A. They found that for 216 participants, sad music evoked significantly stronger mind-wandering than happy music when taking part in a probe-caught thought sampling experiment where participants were required to self-report their own mind-wandering state immediately after listening to audio excerpts (using only instrumental music – either film or classical), both on a rating scale and through qualitative elements. They also found in Experiment 1B that tempo has an effect on mind-wandering, with higher levels of mind-wandering occurring for slow music compared to fast music of the same emotion. More recent findings have shown how listening to different types of music can affect our thoughts in that listening to heroic-sounding music evokes more positive and empowering thoughts compared to sad-sounding music which can evoke more negative thoughts (Koelsch et al., 2019). This raises the question of whether investigating different types of music, for example genre, can also affect these positive and negative thoughts, and if different genres of music evoke different levels of mind-wandering.

The following experiment aims to replicate the findings from Experiment 1A in Taruffi et al.’s study (2017), as well as look further at the effects of musical genre in relation to mind-wandering. The experiment also investigates whether musician status (i.e. being a musician or non-musician) affects mind-wandering levels when listening to excerpts of different

musical genres, emotions and durations. The population sample taken was Durham University students between the ages of 19-24 and so the investigation chose specifically to look at young adults. Participants were asked to complete an online survey whereby they were presented with eight different audio stimuli and asked to self-report how focused or distracted they were from the excerpts.

Looking at the original study and the further expansion, three hypotheses arise for this experiment. The first hypothesis is that participants will self-report higher levels of mind-wandering when listening to sad music compared with happy music based on the results from Taruffi et al.'s study. The second hypothesis is that there will be a difference in mind-wandering ratings between the three different genres (opera, folk and rock). The third hypothesis is that musicians will self-report lower levels of mind-wandering compared to non-musicians, supported by Madsen and Geringer's (1990) study in the differences of attention for musicians and non-musicians during music listening.

## 2. METHOD

**Participants.** There was a total of 23 participants in this experiment (9 non-musicians and 14 musicians) ranging from 19 to 24 years old. There was a mean age of 20.5 years ( $SD = 1.34$ ). Participants were to self-assess their level of musicality and place themselves into categories based on Ollen's study (2006). Two participants recorded themselves as non-musicians, seven as 'music loving' non-musicians, eight amateur musicians (up to grade 8 standard), five serious amateur musicians (diploma level or above) and one professional musician. Participants were all Durham University students and were drawn using volunteer sampling via an online Qualtrics survey that was shared on social media platforms available to Durham students.

**Apparatus and Stimuli.** The apparatus used in this study consisted of an online Qualtrics survey made up of multiple questions for each participant. This survey included twelve excerpts of music which differed in genre (rock, folk or opera), emotion (happy or sad) and duration (40 seconds or 80 seconds). All twelve excerpts of music contained lyrics. The survey also included a practice trial with an unrelated excerpt (A-ha – Take on Me). *Table 1* shows the twelve excerpts used in the survey.

**Yellow** = 40 second excerpt

**Green** = 80 second excerpt

Table 1. Audio Tracks used in the Online Survey.

Genre	Happy		Sad	
Opera	Mozart - Magic Flute;	Rossini - The Barber of Seville;	Purcell - Dido and Aeneas;	Puccini - La Bohème; Some
	Papagena-Papageno	Largo al factotum	Dido's Lament	and
	duet			
Rock	Bon Jovi - Livin' on a Prayer	Black Veil Bride - I am Bulletproof	Metallica - Fade to Black	Queen - The Show Must Go On
Folk	The Pogues and the Dubliners - The Irish Rover	Flogging Molly - Drunken Lullabies	Mary Black - The Rose of Allendale	The Dubliners - In the rare old times

"Happy" and "sad" audio stimuli were selected by the researchers and then confirmed in terms of emotion on the basis of brightness, key clarity and RMS energy tested through acoustic analysis. This was done via MATLAB software using the MIR toolbox (Lartillot, Toivainen & Eerola, 2008). Extracts of a low brightness rating were deemed to be "sad", whilst extracts of a high brightness rating were deemed to be "happy". The brightness rating was the most important factor in distinguishing between happy and sad music, whilst the key clarity and RMS energy ratings helped to confirm these findings. For example, *Figure 1* shows that the average coefficient value of brightness for the "Flogging Molly" excerpt in the happy folk category (.60), compared to *Figure 2* which shows a lower average coefficient value (.40) for "The Dubliners" in the sad folk category. For each stimulus, the entire track was acoustically analysed before a suitable extract was chosen to represent the happy or sad emotion. Extracts within the tracks which were noticeably low or high in brightness were chosen to emphasise this difference in emotion and were cut to either 40 or 80 seconds using Audacity before being placed in the Qualtrics survey. This acoustic analysis was undertaken to ensure that any bias of choosing the extracts based on subjective opinion was eliminated.

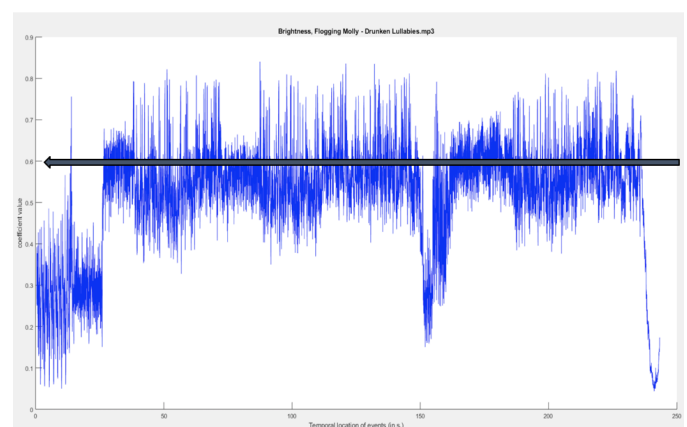


Figure 1. A graph showing the brightness levels for "Flogging Molly" in the happy folk category.

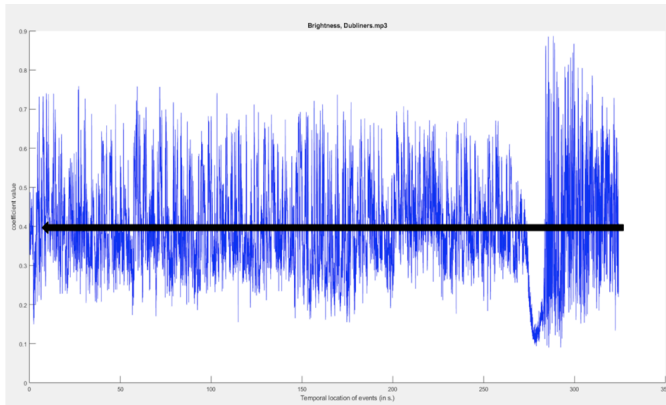


Figure 2. A graph showing the brightness levels for “The Dubliners” in the sad folk category.

Participants were required to complete the survey on an electrical device (mobile phone, tablet or laptop). Headphones may have been used but were not an essential requirement for the survey. Results were collected and analysed online using the Qualtrics website and Excel.

*Design.* This experiment used a within-subjects design, whereby participants were exposed to all three of the different experimental conditions (genre, emotion and duration of the audio stimuli). The survey was split into three blocks according to genre of music (rock, folk and opera), and the musical stimuli within these blocks were randomised for each participant, with the same procedure being carried out in each block of the survey. The genre blocks themselves were also randomised, with each participant being randomly allocated to listen to two out of the three genre blocks in the survey (eight out of twelve musical excerpts). Participants were not required to listen to all twelve musical excerpts as this may have caused unintentional mind-wandering due to the length of the survey, and so a shorter survey with a decreased likelihood of fatigue effects occurring was preferable.

The independent variable in this experiment consists of three parts: the duration of the excerpt (40 or 80 seconds), the emotion of the excerpt (happy or sad) and the musical genre of the excerpt (folk, opera or rock). The dependent variable is the level of mind-wandering that participants self-reported on a scale of 1 to 7, with 1 being “completely focused on the music” and 7 being “completely distracted from the music”.

*Procedure.* Participants were required to read and consent to information regarding the experiment and answer basic demographic questions such as their age and musician status before continuing with the online survey. An initial practice trial was presented where participants were advised to shut their eyes, make sure that they were in a suitable listening environment and adjust the volume of the music to a comfortable level (with or without headphones). In the practice trial, participants were asked to listen to an unrelated audio track and report their mental experience immediately after listening through self-report. The first question asked participants to rate how much their mind had wandered during

the excerpt on a scale (1 – 7; 1 = “completely focused on the music” / 7 = “completely distracted from the music”). Only if participants answered  $>3$  on the first item, were they asked to provide further detail about the content and the form of their thoughts through the open-ended question (“What were you thinking about during the excerpt?”) in order to provide more in-depth qualitative data.

The experimental trials were then carried out in the exact same format with participants listening to the audio track, this time with the variables of genre (rock, opera or folk), emotion (happy or sad) and duration (40 or 80 seconds) followed by the rating question and then the open-ended question for those who scored  $>3$ . Each participant was randomly allocated to eight out of the twelve experimental trials and so listened to all of the tracks for two out of the three genres in the experiment. A short debriefing was presented at the end of the survey.

### 3. RESULTS

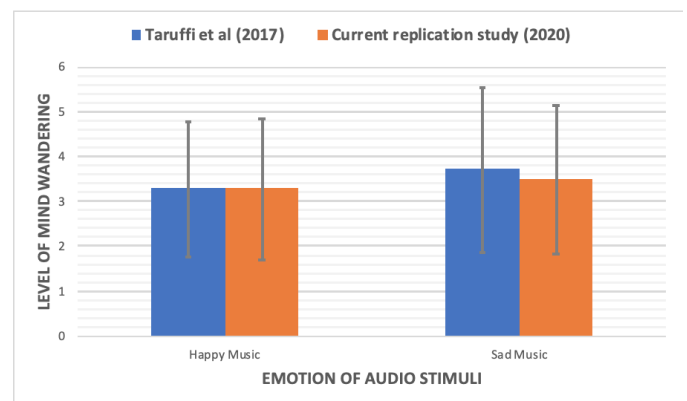


Figure 3. Levels of mind-wandering comparing emotion for the current replication study and Taruffi et al. (2017).

Figure 3 shows that participants within this sample of Durham University students aged 19-24 self-reported higher mind-wandering levels when listening to sad audio stimuli ( $M = 3.49$ ,  $SD = 1.83$ ) compared to happy audio stimuli ( $M = 3.29$ ,  $SD = 1.57$ ). The original study by Taruffi et al. (2017) also showed higher mind-wandering levels when listening to sad audio stimuli ( $M = 3.71$ ,  $SD = 1.83$ ) compared to happy audio stimuli ( $M = 3.28$ ,  $SD = 1.51$ ). This shows a difference of only .01 between the happy audio stimuli scores when comparing the studies, and a difference of .22 for the sad audio stimuli scores.

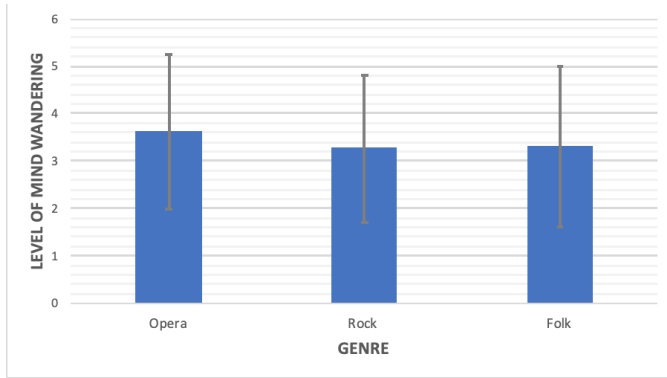


Figure 4. Levels of mind-wandering comparing genre.

Figure 4 shows that participants self-reported higher levels of mind-wandering when listening to audio stimuli from the opera genre compared to the rock and folk genres. The mean mind-wandering level for the opera genre was 3.63 ( $SD = 1.63$ ). The folk genre was the second highest genre for levels of mind-wandering with a mean of 3.30 ( $SD = 1.69$ ), followed closely by the rock genre having the lowest levels of mind-wandering with a mean of 3.26 ( $SD = 1.54$ ). Figure 4 shows the means calculated using data from all of the participants, including both non-musicians and musicians.

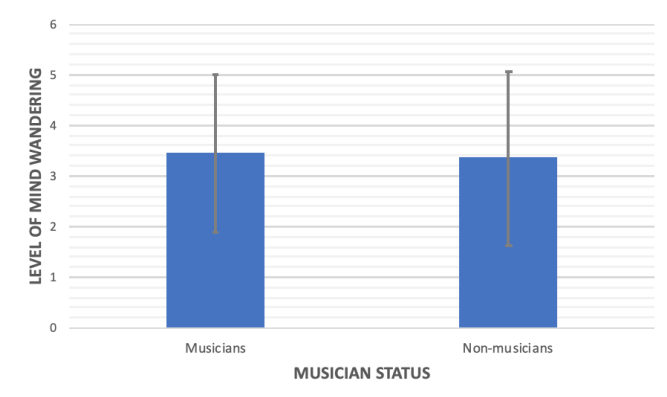


Figure 5. Levels of mind-wandering comparing musician status.

Figure 5 shows the overall mind-wandering scores comparing musicians (amateur, serious-amateur and professional musicians) and non-musicians ('music loving' non-musicians and general non-musicians). Musicians self-reported higher levels of mind-wandering ( $M = 3.46$ ,  $SD = 1.56$ ) compared to non-musicians ( $M = 3.35$ ,  $SD = 1.72$ ). However, Table 2 shows that musicians were more focused for the audio stimuli in the opera and rock genres compared to non-musicians, self-reporting lower levels of mind-wandering. The largest difference for levels of mind-wandering between musicians and non-musicians in terms of genre is in the folk category, where the mean for musicians was 3.69 ( $SD = 1.66$ ) and the mean for non-musicians was 2.33 ( $SD = 1.23$ ), showing a difference of 1.36. Table 2 also shows that the highest levels of mind-wandering occurred in the sad opera category, with a mean of 3.8 for musicians ( $SD = 1.63$ ) and a mean of 4.6 for non-musicians ( $SD = 1.33$ ).

Table 2. Levels of mind-wandering comparing genre and emotion for musicians and non-musicians.

Genre and Emotion									
	Opera			Folk			Rock		
	Overall	Happy	Sad	Overall	Happy	Sad	Overall	Happy	Sad
Musicians	3.56	3.3	3.8	3.69	3.6	3.8	3.06	3.3	2.8
Non-Musicians	3.89	3.3	4.6	2.33	2.5	2.2	3.43	3.4	3.5

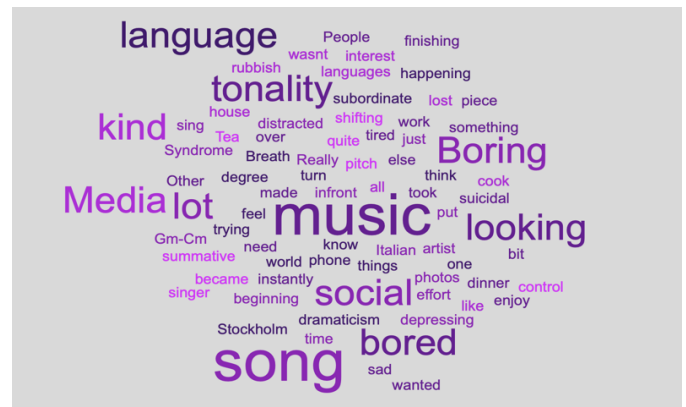


Figure 6. A word cloud showing the qualitative data on mind-wandering collected from the sad opera category for all participants – musicians and non-musicians.

Figure 6 shows the thematic analysis of qualitative responses from the sad opera category which showed the highest level of mind-wandering. These words are in response to the question “What were you thinking about during the excerpt?”, for which participants were required to answer if they scored  $>3$  on the mind-wandering rating scale. Words associated with mind-wandering such as “thinking” and “about” were eliminated prior to the analysis. Words such as “boring” and “bored” are prevalent in the word cloud, with 5 out of 13 written responses for this category reporting a lack of interest or boredom in the audio stimuli. “Media” was mentioned twice, in relation to looking at social media as a result of boredom. “Language” was also mentioned 3 times in the written responses. No other significant pattern was found in the thematic analysis for this category.

## 4. DISCUSSION

The findings of this experiment support hypothesis 1 in that participants did self-report higher levels of mind-wandering when listening to sad music compared to happy music, in line with the original study by Taruffi et al. (2017). The original study found more of a significant difference between happy and sad music in terms of mind-wandering, however the fact that there was only a .01 difference in ratings for happy music between the two studies shows the results to be reliable. The findings also support hypothesis 2 – that there is a difference in mind-wandering ratings between the opera, folk and rock genres, with mind-wandering levels at their highest for the opera genre. The results from this study go against hypothesis 3 – that musicians will experience lower levels of mind-wandering compared with non-musicians. However, this is



only true for the overall ratings of mind-wandering with a difference of .11. A breakdown of the results by genre shows that musicians self-reported lower levels of mind-wandering in the rock and opera categories, with a larger difference of 1.36 in mind-wandering ratings for the folk category compared with non-musicians, suggesting that the difference in genre is more significant than the difference between musicians and non-musicians in the effects on mind-wandering. Further research using a larger sample size of musicians and non-musicians should be undertaken to investigate if this difference has more significance than found in this study.

There are characteristics of each audio stimulus that could have affected the levels of mind-wandering shown in this study that were not controlled for, such as tempo and engagement of the lyrics. Taruffi et al. (2017) showed that music with a faster tempo can evoke lower levels of mind-wandering compared to music with a slower tempo, and so this could have been a contributing factor in our results. The words presented in Figure 6 show that language was a significant topic in the qualitative responses for the sad opera category. However, it is of particular note that 100% of the responses that made a reference to language were for 'Dido's Lament' which used English lyrics, rather than 'La Boheme' which used Italian lyrics, suggesting that the unfamiliar sound of the lyrics was more of a significant factor in relation to mind-wandering than the actual language used.

Looking closer at familiarity, it is possible that the difference in results between genres and musicians/non-musicians can be explained by differing familiarity levels with each audio excerpt and genre presented. The fact that musicians experienced less mind-wandering in the opera category could be explained in terms of musicians possibly being more familiar with these excerpts as they were more likely to be exposed to this genre compared to non-musicians. Equally, the same could be said for why non-musicians experienced lower levels of mind wandering in the folk category as they may have been more familiar with this type of music compared to musicians. However, we did not ask participants to record how familiar they were with the excerpts and so cannot speculate around this. Further developments of this research would benefit from asking participants to record how familiar they are with the excerpts in order to investigate these possibilities.

Feng and Bidelman (2015) reported that listening to familiar music is associated with faster response times and lower levels of mind-wandering compared to unfamiliar music. However, the research in this area has mostly investigated how facilitating or disruptive familiar/unfamiliar music is in terms of mind-wandering whilst performing another task. "Background" music of this kind has been studied in depth, even to the point of investigating and manipulating the peak in the modulation spectrum of background music in order to enhance functional music for everyday use (Woods et al., 2019). There is a distinct lack of research in focusing on the audio stimuli itself in terms of familiarity and mind-wandering. Therefore, further research is needed to look at the effects of familiarity of music in relation to mind-wandering when being asked specifically to focus on the musical excerpts, rather than on an accompanying task.

Furthermore, it should be noted that the sample size in this study was fairly small and only consisted of 19-24 year olds from a Western, educated background. This restricted sample only accounts for 12% of the global population (Henrich et al., 2010) and so the findings cannot be generalised outside of this group. Further research could look at the possibility of investigating different age groups in mind-wandering, as there has been recent research to suggest that older adults tend to mind-wander less frequently than young adults and that this could be attributed to age-related differences in motivation (Seli et al., 2020). Numerous studies have also shown the close relationship between aging, memory and emotions (Charles et al., 2003; Ebner & Fischer, 2014) that are important factors that could affect the level of mind wandering. There is, therefore, scope for further research into these mind-wandering differences attributed to age when having musical stimuli as the sole focus for participants.

The use of the word "mind-wandering" in the online survey from this study could have resulted in participants anticipating the aims of the experiment following the practice trial and adapting their behaviour to intentionally mind-wander or attempt to focus more than usual on the audio stimuli. Weinstein, de Lima & van der Zee (2017) found that using the wording "on task" rather than "mind-wandering" in questions on their thought state allowed participants to focus more on the task in hand. Therefore, future studies in mind-wandering should adapt accordingly and refrain from using "mind-wandering" in the wording of participant questions in order to decrease demand characteristics.

It is also of note that many of the qualitative responses from participants included mentions of social media. Therefore, this experiment could be done in the lab in a controlled environment away from technology in order to eliminate these potentially confounding variables. However, it is important to acknowledge that as mind-wandering occurs frequently in day to day life, it may be of more use to investigate the effects that it has on the cognitive process in a situation which emulates the natural environment rather than taking away factors such as social media which play such a significant part in our lives. Similarly, it is possible that participants took the survey at different times of the day and that this could have affected their mind-wandering levels. Smith et al. (2018) found that mind-wandering was not stable throughout the day, and so comparing musicians with non-musicians would be more reliable if the survey was taken at the same time of day for both sets of participants.

## 5. CONCLUSION

This study replicated the findings of Taruffi et al. (2017), in that participants reported higher levels of mind-wandering when listening to sad music compared with happy music. It was also found that the difference in mind-wandering between genres was more significant than the difference in mind-wandering between musicians and non-musicians. Mind-wandering is a cognitive process that significantly affects people in their daily lives, and so it is important to study and understand this process and the numerous factors which contribute to its fluctuating

levels. This is important for our mental and physical health, and it is crucial that we understand how mind-wandering can be both beneficial and harmful to us. Furthermore, the relationship between music and mind-wandering has important theoretical and practical implications. Theoretically, it contributes to our understanding of how the brain processes music, and how music affects our emotions both directly and indirectly. Practically, research in this area helps advances in music psychology and therapy - looking at the 'healing power' of music and how this can have a real impact on those suffering from mental health issues.

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