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Music-induced emotion: How is this affected by the choice of musical stimuli and the presence of musical training?

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ABSTRACT

Music and emotion are closely linked, yet the extent to which music actually induces emotion in listeners has been a matter of debate. Based on research by Strauss et al., (2024), this study aimed to assess to what extent musical stimuli induced emotions in participants. Using an online survey, data was collected about participants' emotional responses to a selection of musical excerpts from a broad range of genres. Expanding the study design of Strauss et al. allowed the participants to rate their own choice of pieces in an additional section of the survey. Overall, our results for average emotional intensity were much higher than those obtained by Strauss. Furthermore, we found that the average emotional intensity was even higher when the participants rated their own choice of pieces. We also decided to measure if participants' responses were affected by musical training. However, when analysing the data in relation to musicianship, there was no statistically significant difference between musicians and non-musicians. Further research with a larger sample size would be required for a better assessment of the impact of musical training on music-induced emotion.

1. INTRODUCTION

Interest in the relation between music and emotion has been growing for several decades. One important area of research has been discerning the difference between perceived and felt emotion in music. Perceived emotion is the emotion that a listener believes the music to be expressing, such as sadness or anger - whereas felt emotion is the emotion that is physically induced in the listener by the music (Strauss et al., 2024). Zentner et al. (2008) investigated emotions evoked by music and found that perceived emotion is often greater than induced emotion. In order to measure music-induced emotion, Zentner also devised the Geneva Emotional Music Scale (abbreviated as GEMS). The largest version of the scale (GEMS-45) has 45 labels categorised into 9 emotional dimensions, which are then grouped into 3 higher order factors: sublimity (wonder, nostalgia, peacefulness, tenderness, transcendence), vitality (joyful activation, power) and unease (sadness, tension). The GEMS model aimed to counter limitations from other emotion models sometimes used in music and emotion studies. For example, the basic emotions theory focusses on survival emotions such as anger and disgust (Ekman, 1992). These emotions have been described as 'utilitarian' rather than 'aesthetic', hence limiting their use into the research on music-induced emotion (Scherer & Zentner, 2008). Another model that has been used is the circumplex model, which marks emotions in a two-dimensional space based on valence and arousal (Russell, 1980). However, some emotions on the circumplex model, such as anger and fear, lie very close together. This may give them the appearance of being very similar even though they can feel very different in a musical context, which suggests the circumplex model is still inadequate when analysing the effects music has on human psychology (Juslin & Laukka, 2004). The GEMS scale, on the other hand, features a bias towards positive emotions since Zentner et al. found that negative emotions are rarely felt in response to music. Although Zentner's original study focussed mostly on Classical music, GEMS has also been found to be suitable for measuring emotion induced by different genres: Aljanaki et al. (2016) observed no significant difference in inter-reliability ratings across the Classical, Pop, Rock and Electronic genres.

Gerstgrasser et al. (2023) used the GEMS model to study the effects of personality, musical expertise and current mood state on music-induced emotion. Participants were divided into musicians (experts) and nonmusicians (non-experts), based on their self-reported musicianship status (where 1 = nonmusician and 5 = professional musician), weekly practice time and the presence/absence of musical qualifications. Their most salient finding was that musicians experienced greater emotion in response to musical stimuli than nonmusicians. However, our study was primarily based on research by Strauss et al. (2024), who were investigating music and emotion to create an online database, the Emotion-to-Music Mapping Atlas (EMMA). As devised by Zentner et al. (2008), 567 participants aged 16-76 rated a broad range of musical stimuli for emotion using the GEMS model. Participants used GEMS-45 to rate a series of short musical excerpts (30-60s in length). The musical excerpts comprised 3 genres: Classical (including Baroque, Classical, Romantic and Modern), Rap/Hip-Hop, and Pop. Overall, Strauss et al. found that music does elicit emotion in listeners but only to a small extent. However, participants were only allowed to listen to pre-selected excerpts; the impact of

self-selected musical examples on emotional intensity will be addressed in the second half of this study. A previous research study that used participant-selected musical stimuli found that the excerpts that are associated with personal memories tend to induce higher levels of emotion (Maksimainen et al., 2018). Therefore, we hypothesised that participant-selected musical stimuli would induce higher levels of emotion than excerpts selected by the experimenters.

2. METHOD

Design. This study used an online survey to collect results. Participants listened to 7 musical excerpts from a range of genres and rated each piece for emotion using GEMS-9, a condensed version of the GEMS-45. GEMS-9 has 9 emotional labels: joy, nostalgia, peacefulness, sadness, tenderness, tension, wonder, transcendence and power. Participants then listened to 3 pieces of their own choice and performed the same rating scale.

Participants. 24 participants were recruited using convenience sampling. 23 of those participants completed Section A, while only 21 participants completed both Section A and B. Of the 23 participants, 11 were male, 11 were female and 1 was not described. Ages ranged from 18 to 60 (M = 36.7, SD = 17.5). One question from the Ollen Musical Sophistication Index (OMSI) questionnaire was used to determine whether the participants identified as musicians or non-musicians (Ollen, 2006). In total, 14 participants identified as musicians and 9 as non-musicians, in which the musicians described themselves as 'amateur' to 'semi-professional musician', while non-musicians described themselves as either 'nonmusician' or 'music-loving nonmusician'.

Stimuli. Musical excerpts in Section A were all 30 seconds long. We aimed to cover a variety of musical genres, as in Strauss et al.'s original study. 1 excerpt was taken from each of the following genres: Baroque (18th century), Romantic (19th century), 20th Century, Jazz, Rock, Pop, and Rap/Hip-Hop. List of excerpts: Bach, Brandenburg Concerto No.3; Chopin, Etude Op.10 No.12; Shostakovich, String Quartet No.8; Ande, Louis Smith; AC/DC, Highway to Hell; Miley Cyrus, Party in the USA; Eminem, Lose Yourself. A YouTube clip was inserted for each musical excerpt and participants were allowed to replay the clip as many times as required. Participants were then asked to listen to 3 pieces of their own choice: no particular time limit was specified for each piece as this would be impossible to control.

Procedure. Data collection was carried out using an online survey, which was made with Qualtrics. The survey took approximately 15 minutes to complete. All participants consented to the study in order to continue the survey. First, the participants answered a selection of basic demographic questions. Then, participants were guided through one practice excerpt before starting Section A, which involved 7 musical excerpts. After listening to each excerpt, participants rated the music for different emotions using the 9-point GEMS scale. Participants rated the emotional intensity of each emotion on a scale of 0-100, where 0 was no felt emotion. Participants then rated each piece for familiarity and liking. Section B of the survey had a similar format: participants listened to 3 pieces of their own choice, answering the same questions for each piece. The questionnaire first prompted the participants to state the name and artist of their chosen pieces. They then rated their chosen pieces for emotion using the GEMS-9 scale, followed by the same questions asking them to indicate liking and familiarity.

3. RESULTS

Overall, our results were significantly higher than those obtained by Strauss et al. The ratings for emotional intensity ranged from 28.83 (sadness) in section A, to 69.54 (joy) in section B (see fig.1). The most intensely evoked emotion in section A was power (M = 57.02), followed closely by joy (M = 52.99). In section B, the most intensely evoked emotion was joy (M = 69.54) and the least intensely evoked emotion was tension (M = 46.39).

The intensity of emotion induced was significantly higher in section B than in section A (A: M = 42.35, SD = 15.40, B: M = 59.21, SD = 8.37). A related t-test was run to establish whether the results were significant. The test showed that the difference between the 2 sections was statistically significant, $t(8) = -5.71$, $p = .00022$.

There were also differences in the intensity of emotion evoked depending on genre (see Fig. 2). Based on the results from Section A, the excerpt that elicited the highest amount of emotion was the Romantic nineteenth-century piece, whereas the excerpt that elicited the lowest amount of emotion was the Rock piece.

Figure 1

Intensity of induced emotion for each section

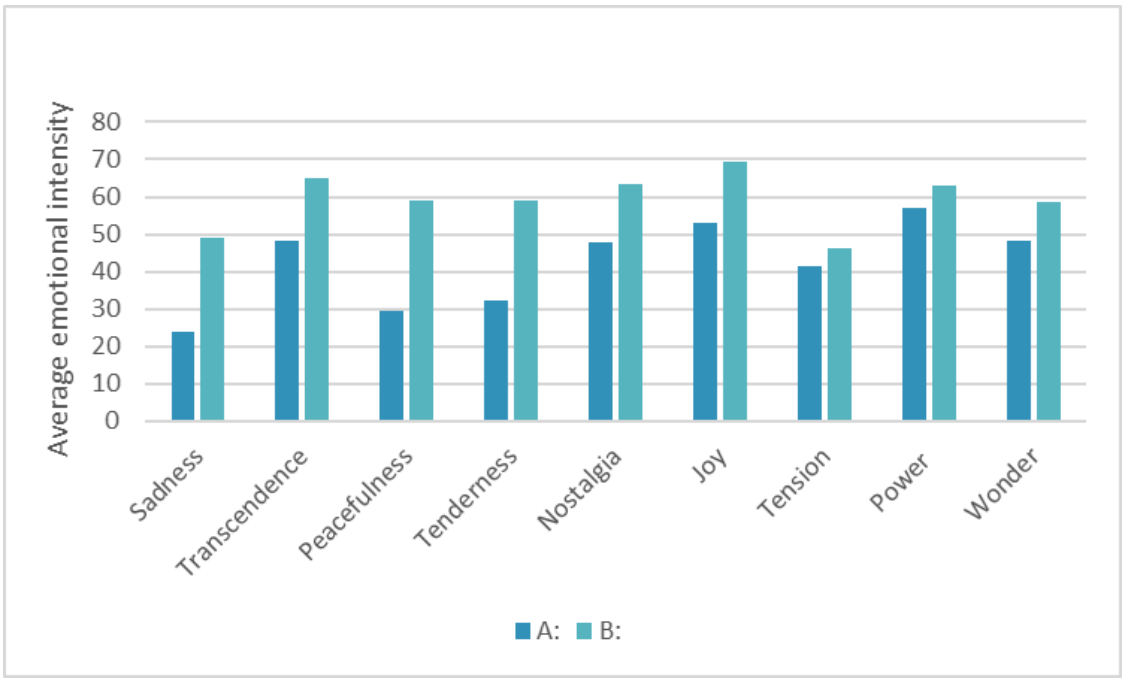
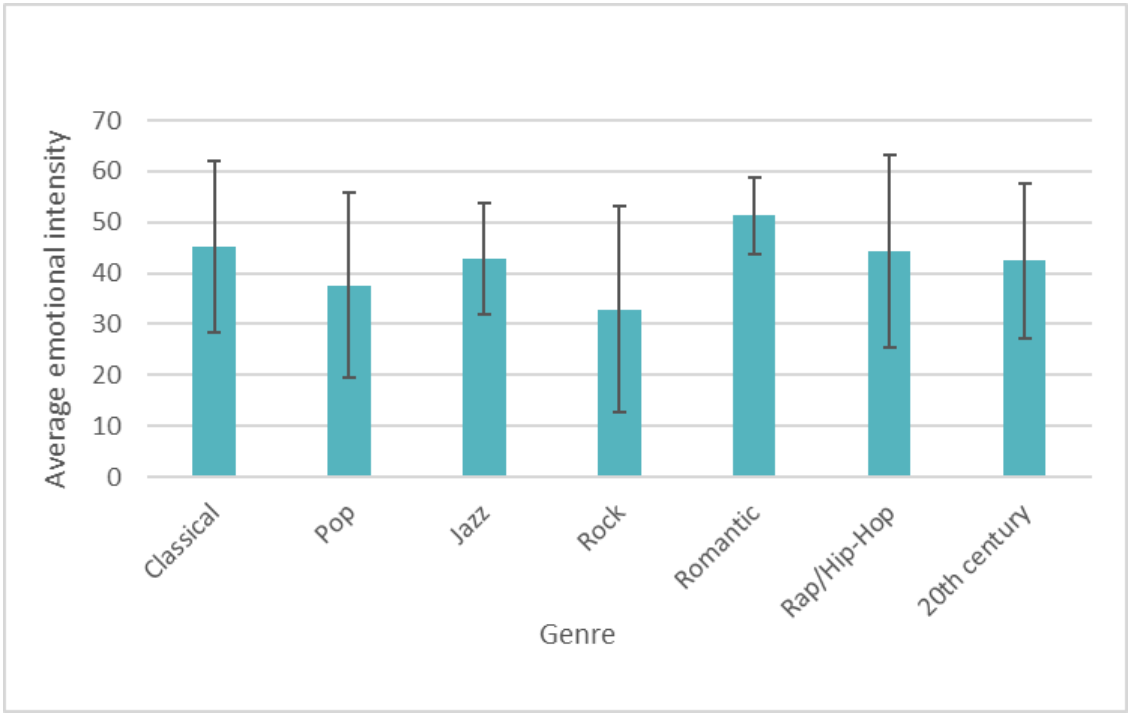


Figure 2

Average emotional intensity elicited by each genre



Another of our aims was to establish whether there was a difference between musicians and non-musicians; in so doing we separated the data into those 2 categories (see tables 1 and 2). On average, non-musicians gave higher ratings than musicians in both sections. However, an unrelated t-test showed that the results were not significant in either section: for section A, $t(12) = -1.34$, $p = 0.20$; for section B, $t(14) = -0.83$, $p = 0.42$.

Table 1

Difference in average emotional intensity between musicians and non-musicians for section A

	Musician	*Non-Musician*
Average	23.20	31.54
St Dev	10.38	16.64

Table 2

Difference in average emotional intensity between musicians and non-musicians for section B

	Musician	*Non-Musician*
Average	42.27	48.36
St Dev	14.63	16.85

4. DISCUSSION

A striking outcome of our study is that our results were significantly higher than Strauss et al., where average emotional intensities only ranged from 3.21 (sadness) to 19.76 (joyful activation). There are various explanations for this. First of all, there were some demographic differences. Strauss et al. had a majority of German participants, with just under half of the participants completing the study in German. All of our participants were recruited from English-speaking countries. There could be cultural differences which may affect how participants are affected emotionally by music, or, affect the extent to which they report emotional intensity. Secondly, whilst our age range was similar to Strauss et al., whose participants ranged from 16-76, our participants tended to be clustered into 2 main age categories: 18–22 year-olds (11 participants) and 46–66 year-olds (12 participants). However, the averages for both categories were actually remarkably similar, with average emotional intensities of 31.36 and 30.79, respectively. This suggests that age is not a factor in determining the strength of emotion elicited by music and does not explain why our results were higher than Strauss et al..

A different explanation for why our results were higher than Strauss' could be that the participants misunderstood the difference between felt and perceived emotion. As already stated by Zentner et al. (2008), perceived musical emotion is generally greater than felt emotion. Although we did specify on each question that participants should rate the pieces based on how the music made them feel and not on what emotion(s) the music expressed, the participants might have ignored this warning. Also, some participants had the inclination to give either 100/100 ratings or 0/100, while others had all their results clustered around the middle of the scale. It was mostly those participants who habitually rated the emotional intensity as 100/100 which raised our averages for all excerpts. Since the questionnaire used a sliding scale, these participants may have found it easier to move the slider directly to 100 or leave it at 0, rather than choosing a more precise value between 0-100. Perhaps a scale of 0-10 would have been easier for participants to relate to as one no longer needs to consider the difference between a 45/100 and a 50/100, for example.

Another reason for the difference in findings is that Strauss et al. used the full version of the GEMS scale, which had 45 emotional labels. These described more specific feelings such as 'stimulated', 'sensual', 'fiery' and 'allured'. Peer-Ole Jacobsen et al. (2024) compared the GEMS-9 to the GEMS-45 and also found that the GEMS-9 tended to elicit higher responses. However, it also could be argued that some of the emotions listed in GEMS-45 generally occur at a lower intensity than more generic emotions in a musical context, such as joy. Since the scale was rated from 0-100, it was probably difficult for participants to imagine what being 100% allured felt like, especially in response to a piece of music. This also leads to the issues over the subjectivity of rating emotional intensity. Different participants may have different internal definitions for strength of emotion.

For example, 40/100 for one participant may be a strong rating for emotion, whereas for another person it would be only a mild indication.

Whilst our results for section A were higher than Strauss et al., they were still not excessively high, showing that music's intrinsic power to elicit emotion is limited to some extent. Our main extension to Strauss et al.'s study was that we gave our participants the opportunity to select their own musical stimuli. Overall, these elicited stronger emotional responses than in section A of the study. This was probably due to the fact that participants had formed associations between the music and particular episodes of their lives, which in turn were associated with certain emotions. This aligns with existing research studies, such as those by Schulkind et al. (1999) and Maksimainen et al. (2018). In this case, the associative power of music might play a greater role than any intrinsic features of the music itself.

Although there were differences in emotion evoked depending on genre, the fact that only one piece of music was presented from each genre has prevented us from drawing any strong conclusions about this. Also, although the Rock piece had the lowest overall average for emotion, this was mainly due to the fact that it mostly induced the emotion of power and therefore had much lower ratings for all of the other GEMS labels. Hence, it received a much lower average than all the other genres. This shows that GEMS-9 may not represent emotional intensity but rather the range of emotions evoked.

When we attempted to find a difference between the musician and non-musician categories, we found that participants who self-described as non-musicians on average gave higher ratings but it was not statistically significant. Again, this was similar across both age categories. This contrasts Gerstgrasser et al. (2023) although our sample size was comparatively fairly small. Also, Gerstgrasser only used Classical music examples, but our results displayed the same pattern even if only taking the Classical excerpts into account (Excerpt 1: musicians, $M = 26.72$; non-musicians, $M = 38.15$). A further limitation of our results is that we did not record the actual length of musical training, instead relying on participants to self-describe as either musicians or non-musicians without any reference to what that meant. Had we asked participants to specify the length of any musical training they had received, we may have been able to establish at least whether there was any correlation between length of musical training and intensity of music-evoked emotion. Overall, further research with a larger sample size would be required to establish any clear conclusions.
Another issue with our study was that some labels of the GEMS scale were perhaps too abstract for the average music listener to understand. For example, we received feedback that the term 'transcendence' was unclear. Some participants may have simply made subjective assumptions about its meaning, which decreases the validity of their ratings. Perhaps we should have added descriptors for each label with examples of how the emotion feels. Potentially, these could have been the emotional terms from GEMS-45, which presents a wider range of adjectives for music-evoked emotion. Nevertheless, all terms on the scale were used at least once for every excerpt. This suggests that the terms present in GEMS-9 do provide a wide range of valid descriptors for music-induced emotion.

5. CONCLUSION

In conclusion, our results indicated that music induces emotion to a relatively small extent, yet still higher than previously indicated. Furthermore, the ability of music to induce emotion increases when participants select their own musical stimuli, likely due to familiarity and emotional associations. Age does not appear to be a factor when assessing intensity of music-related emotion, nor does musical training. However, further research will be needed to clarify the latter. The GEMS scale does appear to be a valid measure of music-related emotion but some terms such as 'transcendence' may require clarification for participants.

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