How the Emotional Content of Music Affects Player Behaviour and Experience in Video Games

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***Abstract*—Previous research studying music's effect on video games has focused on musical properties, such as tempo, to create particular emotional player experiences. However, music is complex, and selecting music using a particular parameter may not guarantee that the music will be experienced in a particular way (e.g., higher-tempo music will not necessarily make a player feel more rushed, as previous work implies). Through a player study, we demonstrate that music labelled by its emotional content (e.g., peaceful or powerful) could provide a better means for designers to choose music for particular emotional effects. Our results show that powerful (rather than higher tempo) music can significantly increase experienced tension and risk-taking play style compared to peaceful music. We provide game designers and composers with critical new information about how music can be chosen and designed to target play experience and shape player behaviour, suggesting that music's effects in gameplay need to be studied more holistically.**

***Index Terms*—Sound and music computing, Interaction techniques, Interaction design, Computer games**

I. Introduction

In video games, music is an integral part of a player's gaming experience, capable of affecting both their performance and immersion [26]. Yet, capturing the experience of listening to music is complex, and the properties that lead music to impact players are still not well understood. In movies and television, it is well-known that music affects the viewer's emotional state [6]. In games, designers modify music to match the experience they seek to invoke [16], which not only affects how the game *feels* [16], [26] to players but also their *behaviour* in the game [24], [26].

Previous studies have shown how simple musical parameters such as tempo can affect players. In particular, they demonstrate that higher-tempo music with a "happy" affect (i.e., higher arousal and valence) can lead to increased risk-taking behaviour and immersion compared to more "neutral" music [24]. However, work in music psychology has theoretically and empirically identified the *emotional content* (or affect) of music [2], [33]. Explorations of these datasets reveal the complexity of music – the emotion or feel of a song cannot be explained by a simple parameter. For example, lower tempo music can be more "powerful" ("strong, heroic, triumphant, energetic") due to other factors when compared to higher tempo music, which can sometimes be classified as more "peaceful" ("relaxation, serenity, meditativeness") [2].

Building from this previous work (e.g., [24]), we explore whether music with different *emotional content* can affect player *behaviour* and *player experience*. Understanding if it is the *emotional content* or *musical properties* (e.g., tempo) of music that leads to the differences would provide potentially more direct and useful criteria for game designers to select music that gives players a target experience.

We conducted a user study where 36 participants played two game versions, with each version varying only by the emotional content of the background music: one version used *peaceful* music, the other used *powerful* music [33]. Our findings show that the emotional content of music can affect player experience and behaviour. Specifically, powerful music made players feel higher tension and increased their risk-taking behaviour and performance. Our results extend prior work, demonstrating that the emotional content in background music is a more likely explanation for these differences than other musical properties (e.g., tempo). These results are a springboard for deeper studies into music's effects on gameplay and advocate for further research into applications of standardized emotional labels for music in games.

II. Related Work

Music's impact on human behaviour, encompassing mood, actions, and perceptions, has been widely acknowledged [3], [7], [31]. Research shows that video games can influence player behaviour, affect performance and immersion, and change risk-taking behaviour [9], [14], [15], [24]. However, previous work has largely focused on specific musical properties, such as tempo, or has varied musical properties systematically with different emotional content [7], [14], [19], [24].

Music's emotional content has been previously classified through various means, including valence and arousal, tempo, chord structure, or their combinations. While valence and arousal are commonly studied in video game music research, offering a simple parameterized emotional model, they are better suited for determining which dimensional model of emotion to use [4]. Tempo, while also commonly studied, has limitations in predicting emotional affect or risk-taking behaviour [19], [24]. Changes in tempo can significantly alter player performance [14], [24], but various factors like prolonged exposure and player skill can mitigate this effect [19]. Specific musical features (e.g., pitch direction, register, and volume), have been explored for their impact on emotional states like tension [11], [23]. Emotional congruency between music and gameplay, coupled with increased perceived tension, enhances player experience, potentially boosting immersion [28]. Despite the recognized influence of music on emotional responses, the intricate connection between music, emotion, immersion, and behaviour remains complex [9], [25], [29].

Similarly, the link between music and player behaviour is also underexplored beyond changes in tempo, tension, and performance [19]. Studies have shown that musical presence affects risk-taking behaviours and decision-making [24]. Music's capacity to evoke mental and physical effects has been documented [12], [27], influencing brain motor processing and emotions [12], but how music impacts emotion and behaviour remains a complex area of study [17].

Music is often described with emotional adjectives, reflecting basic emotion theory [5]. Measuring emotional responses to music involves rating songs with various metrics mapped to emotions, such as valence and arousal models or word associations [27]. Similar emotional content of game music can be found across music genres, emphasizing the role of emotional content over genre [29]. Models like the Geneva Emotional Music Scale (GEMS) offer a more specific classification of the emotional experience of music, and there is a human-rated database of music with GEMS emotional labels [2]. Our study leverages this database and the insight that simple musical properties may have limited usefulness in describing and predicting how music is experienced and its effects.

Our study builds on other prior research that showed how simple musical parameters (e.g., tempo, pitch, valence, or arousal can impact player behaviour, performance, and experience) by specifically focusing on the effects of higher-level emotional content. Utilizing music with validated emotions from the GEMS database [2] as background music in a video game, we measure players' risk-taking behaviour, experiences, immersion, and performance. Our results aim to contribute to a more nuanced understanding of how emotional content in music can be leveraged for creating distinct game experiences, providing valuable insights for future game design and research on the impact of music on player experience.

III. Method

To explore how the emotional content of video game music impacts player behaviour and experience, we conduct a within-subjects study where participants play a game in which risk-taking behaviour would affect their performance. We leverage a framework for emotional content in music to select background music with different emotional classifications (peaceful and powerful) and measure changes in player behaviour, experience, and immersion for each music type.

A. Background Music Selection

To select music with a specific emotional impact on players, we used the GEMS database [33] as our source of music and verified emotional content labels. From the GEMS database [2], we selected music with emotional content that we believed would likely produce a difference in player risk-taking behaviour - *peaceful* and *powerful* music. The GEMS scale is a tree of increasingly specific categories of emotion, with more specific terms in the lower order factors [33].

We conducted a brief pilot study to validate perceived song effects. From the GEMS dataset [2], which contains 100 sixty-second song excerpts from four genres of music, we first excluded pop and rock songs based on our subjective perception of the lack of congruence with the Redline gameplay. This left electronic and classical music. We chose five classical and electronic songs each from the dataset that scored high in power and low in peacefulness and five songs each that scored high in peacefulness and low in power.

15 participants listened to all full 1-minute clips and ranked each group of songs from most to least peaceful and powerful. Additionally, pilot participants rated a song by selecting true or false as to whether a song could be described by the following adjectives: amazement, solemnity, peacefulness, nostalgia, calmness, power, joyful activation, tension, and sadness. Participants had not listened to any of the songs selected before this pilot study. The most peaceful and powerful songs were selected for the main experiment: *Eye Heart Knot* by *General Fuzz*, and *Unknown Quantity* by *Mr Gelatine*, respectively. We note that the peaceful song had a tempo of 91 beats per minute – *higher* than the powerful song (83 beats per minute), though prior work suggests a higher tempo should create more tension. No songs had the same tempo; however, previous work has considered music within this range to be roughly emotionally equivalent ("medium tempo (76–120 bpm)") [20].

B. Apparatus

Redline is a 3D, web-based, voxel-styled, top-down firefighting game developed in Unity. It was originally used to study the behavioural effects of manipulating the health visualization on player risk-taking behaviour [32]. Players put out several fires per level, with varying positions and numbers of fires per level throughout the same building layout. The fires slowly spread if uncontrolled and damage the player when close to the the fires. The player can move freely and spray water on the fire, reducing its intensity until it is eventually put out. Spraying water on the core of the fire will put it out faster, but that requires getting closer to fire, which puts the player in danger. Thus, some risk-taking is encouraged and will help finish a level more quickly, but the game is balanced such that risk-taking behaviour is not required for success. Level difficulty is defined by the number of fires present and the intensity of the fires.

C. Music Volume

Music volume is known to impact tension [11], and was a concern as a potential confounding variable as the entire study was conducted remotely, making it difficult to monitor participants' game volume due to differences in hardware and software settings. We implemented a volume calibration screen before participants would enter each gameplay session. The music for that gameplay session would begin playing as soon as the screen appeared, prompting players to adjust the slider on the screen until they could hear the music at a comfortable level, with the minimum possible volume still playing sound to prevent complete muting. We further confirmed participants could hear the music in a post-experiment interview.

D. Participants

We recruited 36 participants for this study (pilot participants were excluded), aged 18-29 years (mean=23, SD=3.2). All the participants reported playing video games; however, no participants had prior experience with Redline. 30 participants were students recruited from our local institution via the local computer science faculty's mailing list.

E. Measurements

We collected potential participant biases towards risk-taking behaviour (Barratt Impulsiveness Scale and the Behavioural Inhibition System/Behavioural Activation System – BIS/BAS [8]). These questionnaires measure people's willingness to engage in activities they think will benefit them regardless of risk and their avoidance of risky behaviours. These enable us to separate the effects of our music from personal risk-taking tendencies. Other demographic information included age, gender, and previous gaming experience.

To measure player behaviour, we logged metrics related to performance (e.g., time to complete a level) and risk taking (e.g., proximity to fires) throughout the gameplay sessions. For each level, we collected time taken, damage taken, water sprayed, distance travelled, number of fires in close enough proximity to deal damage, average intensity of the fires in proximity, number of button presses (WASD keys used to control movement), and whether each level was won or lost (due to running out of HP or a timeout). With the exception of the average intensity of nearby fires and level success, each of these data points increases with time taken and was therefore normalized over time.

Post-condition, we measured player experience via the Player Experience Inventory (PXI) [1], workload and stress via the NASA Task Load Index (TLX) [13], and enjoyment, tension, competence, and value with the Intrinsic Motivation Inventory (IMI) [21]. Some overlap exists between these scales, but they provide a broad look at behaviour and experience that could be influenced by musical affect.

We checked participants' perceptions of the music introduced with a custom questionnaire. It consisted of 8 7-point Likert-like questions related to the general awareness of the music, its effect on performance, perception of the tone and speed, enjoyment, and whether participants found the music distracting. In the post-experiment interview, participants were asked to describe their experience playing with both music types and specific questions regarding the effect of the music on their energy, mood, and perceived performance.

F. Procedure

The study was performed remotely, and each session began with a video call to brief the participants on the general procedure of the experiment and ensure they had all the necessary equipment (a minimally capable computer with a mouse, keyboard, and headphones) to use during the study. Participants were not told about what music would be listened to and what data was being measured. We instructed participants to complete the study in a single session in a quiet place without interruptions.

The experiment began with informed consent and several questionnaires – the BIS/BAS, a demographics questionnaire, and a questionnaire regarding previous gaming experience. Following this, the participants would be shown a sequence of images explaining the controls and goal of the game. Participants would then leave the call and complete the experiment individually, rejoining the call for the interview.

Participants first completed 7 training levels of increasing difficulty. These training levels established a base level of proficiency and mitigated learning effects during the main experiment. After training, participants calibrated their in-game volume until the sound was audible. Participants would then play a session of 8 levels, all designed to be more difficult than the training levels (see Figure 1). The order of the condition (music type) was counterbalanced across participants.

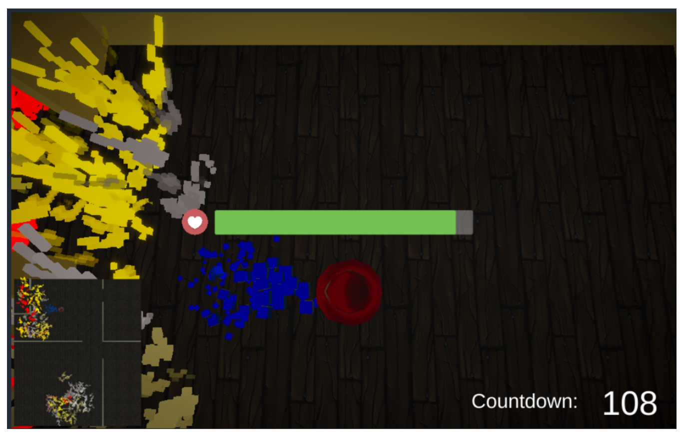

Fig. 1. Redline gameplay example. The top-down view shows the helmet of the firefighter, who is spraying blue water. The interface includes a health bar, a mini-map, and a timer. Fire intensity increases from grey to yellow to red.

After the first game play session (corresponding to one of the two music conditions), the music would stop, and participants would complete the experiential questionnaires (IMI, PXI, TLX, and music questions; see Measurements). This brief interlude provided a respite from gameplay and the opportunity for any potential lasting effects from the music to subside. The second gameplay session played the other music (either peaceful or powerful), but otherwise contained the same levels in the same order, followed again by the same questionnaires. Participants were asked to provide any final comments or questions before joining a final video call for a post-experiment interview. Finally, participants were offered a $10 Amazon gift card.

To avoid issues found in related work on how longer gameplay sessions or skill increases could reduce the effect of music [19], the study length was designed such that players would typically only hear a song repeated 2 or 3 times. Additionally, the set of training levels played before the experimental conditions had no music. This was to help ensure that skill improvement would slow during the experimental conditions and before music was introduced. The experiment took an average of 45 minutes to complete.

Our methodology was approved by the University of New Bruwswick Research Ethics Board (REB #2022-106).

IV. Results

We eliminated 4 participants' data: two participants' systems logged the data incorrectly; one participant took an extended break during a gameplay session; one participant did not understand the controls, resulting in improper use of the mouse. This left 32 participants' data for analysis.

A. Main Findings

We first checked normality with the Shapiro-Wilk test. Normal data was tested with the Student's t-test, and non-normal data used the Wilcoxon signed-rank test.

We found a significant effect of musical emotional content on time taken (p=0.043, t=2.107, d=0.37), with longer player completion times with peaceful music (see Fig. 2). We found that differences were non-significant for water sprayed (p=0.062, t=1.173, d=.38) and number of fires in proximity (p=0.057, W=129.0, d=-.407), see Table I. Other performance measures were also non-significant.

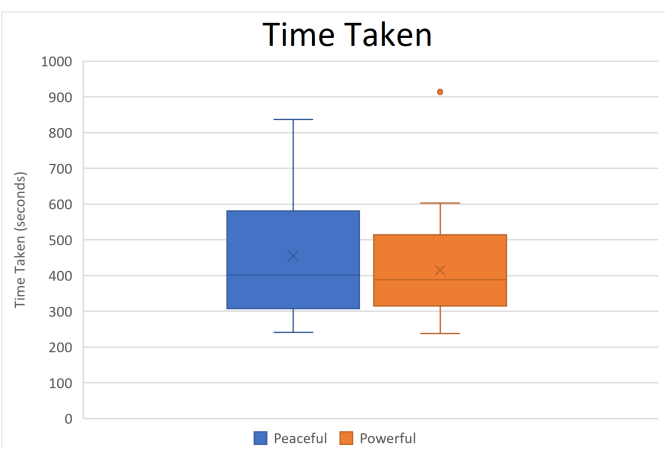

Fig. 2. Time taken per level. Peaceful music led to more time than powerful.

We found a significant difference of musical emotional content on IMI tension (p=0.045, t=-.739, d=-0.370), with powerful music yielding higher tension (see Figure 3). All other IMI, NASA TLX and PXI differences for experiential measures were non-significant.

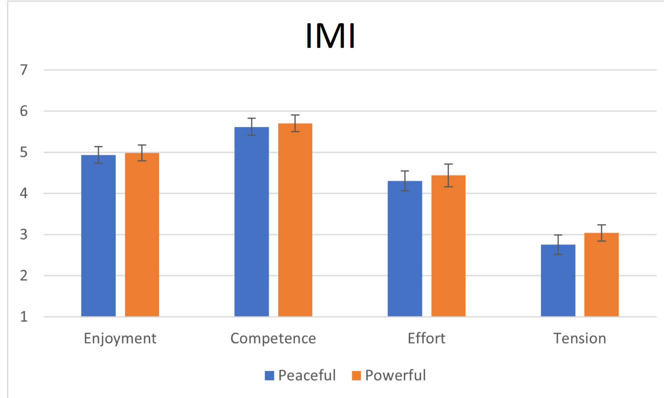

Fig. 3. Mean responses (± SEM) for the IMI questionnaire by dimension: Enjoyment, Competence, Effort, and Tension.

TABLE I
Mean game performance for peaceful and powerful music.

Condition	*Time Taken (s)*	Fires in Proximity	Water Sprayed
Peaceful	455.2	0.8328	0.0143
Powerful	414.7	0.8241	0.0203
p-value	*0.043*	0.057	0.062

We asked Likert-type scale questions (7-point scale, 1=min) about players' other relevant aspects of experiencing music during gameplay. The questions, means, and results of statistical tests can be seen in Table II. For question 1 (p<.001, W=171.0, d=.629), participants reported they did not notice the peaceful music significantly more than the powerful music, and yet for question 5 (p<.001, W=442.5, d=.784) and question 6 (p<.001, W=404.5, d=.740), participants felt the peaceful music matched the gameplay less. Participants also reported that the powerful music was better for helping them achieve their game goals (p=.03, t=-2.154, d=-.493).

We also checked for the effects of order and personal risk-taking tendencies. We performed repeated-measures ANOVAs on the effects of order on our major measures with risk-taking tendencies as covariates. We found a main effect for the BIS scale for predicting the number of fires in proximity (p=.042, $F_{1,29}$=4.51, n^2=.14). We found lower BIS (inhibition from risky behaviours) was correlated with more fires being in proximity (p=.036, r=-.37). All other main effects of BIS/BAS scales on other metrics were non-significant.

	Peaceful M(*SD*)	**Powerful** M(*SD*)	p
1. I did not notice the background music	2.19 (*1.38*)	1.56 (*0.98*)	*0.011*
2. The music helped me achieve my goal in the game.	3.59 (*1.60*)	4.31 (*1.79*)	*0.033*
3. I was aware of my music's effect on my playing	4.75 (*1.67*)	5.13 (*1.76*)	0.261
4. I found the music helped me to perform better in the game	4.0 (*1.67*)	4.63 (*1.64*)	0.143
5. I found the music's tone did not match the gameplay	5.5 (*1.72*)	2.88 (*1.66*)	*0.001*
6. I found the speed of the music did not match the gameplay	5.22 (*1.84*)	2.97 (*1.66*)	*0.001*
7. I found the music distracting	3.19 (*1.79*)	2.75 (*1.62*)	0.211
8. I enjoyed the music	5.29 (*1.76*)	5.16 (*1.63*)	0.804

TABLE II
Mean, std. dev. p-values questions related to music experience during gameplay. Sig. diffs. are italicized.

We found no main effects of condition order on our music types, and two interaction effects. We found an interaction effect between emotional content of music and time (p=.04, $F_{1,29}$=4.62, n^2=.04). Bonferroni corrected post-hoc tests found participants took longer with the peaceful music when it was played before powerful music (p=.026, t=-3.09). We also found an interaction effect between emotional content and average distance to a fire (p<.01, $F_{1,29}$=11.7, n^2=.03). Bonferroni corrected post-hoc tests found participants kept more distance from fires during the powerful condition when it was second (p<.01, t=-3.66), which suggests a carryover effect of peaceful music on behaviour to the powerful condition.

B. Qualitative Data

In our post-experiment interview, three participants, unprompted, mentioned feeling anxious or stressed when listening to the powerful music, while four participants mentioned feeling calm or relaxed when playing with the peaceful music. This coincides with the expected induced emotion for each type of music. 26 of the 36 participants noted their enjoyment, or lack thereof, for the music, with a majority attributing their lack of enjoyment to how the music's fit for the gameplay. Of those 26 participants, 16 preferred listening to the powerful music. 22 participants noted that they felt the powerful music had a lasting emotional effect after gameplay, while only 3 participants noted any lasting effect from the peaceful music. 11 participants had comments regarding a lack of challenge after a working strategy was developed.

V. Discussion and Future Work

Our study provides the following 7 main findings:

- Powerful music increased player tension during play despite having a similar tempo.
- Players completed levels faster with powerful music.
- Players noticed powerful music more but felt the peaceful music did not match the tone or speed of gameplay.
- Players felt that the powerful music helped them achieve their goals in the game.
- Players who played with peaceful music first displayed less risk-taking behaviour and were slower to complete levels when they played with powerful music later on.
- Player's risk inhibition predicted risk-taking behaviour.

Together, these results suggest that the powerful music influenced player behaviour toward increased risk-taking, as (by design) completing a level faster in Redline required players to enter damaging areas to put out the more dangerous fires first. Along with the increased tension, this suggests players felt more rushed or willing to take risks when the powerful music played. Players reported that music influenced them towards riskier but more effective behaviour, which is further supported by observed tendencies to be closer to the fires on average with powerful music.

Musical emotional content impacted player tension, but not other IMI and PXI items. Perhaps the music did not change non-emotional measures like "Effort" or "Competence." Or, these common player experience questionnaires may not fully capture emotional effects. Our results suggest game music has a poorly understood role in experience and behaviour that should be better explored, quantified, and understood.

A. Why did powerful music increase tension?

Powerful music created more perceived tension and was viewed as better matching the gameplay. While the increased tension for powerful music was an expected result, some prior work suggests we should have seen a higher enjoyment rating due to the better gameplay match [23], which was not supported in our data. One explanation could be flow theory, which suggests enjoyment is strongly dependent on challenge in games [28]. Most of our participants reported a lack of challenge, which could explain the enjoyment results, regardless of tension or the match with gameplay. Also, changes in tension, mood, or enjoyment can greatly influence the sense of flow and, subsequently, gameplay behaviour and perceived difficulty [10], which may override other sensory experiences like music [18]. Thus, our results do not necessarily disagree with prior findings but highlight that game design and play experience must be studied holistically. Further study is needed to clarify the relationship between the emotional content of music and its congruence with gameplay, tension, challenge, and enjoyment.

B. Simple music parameters are not enough

In the post-experiment interviews, participants reported that the peaceful music was "too slow" and "did not match the gameplay," they rated it as slower and less enjoyable than the powerful music. The peaceful music had a tempo of 91 beats per minute, compared to the powerful's 83, suggesting that the emotional content of a song, its match with the gameplay, or both together can influence the perceived tempo of the music. Previous work in video game music found tempo as a significant factor that can change perception or behaviour. It could be that tempo alone is a poor predictor of the effect music has on behaviour and play experience, and other related qualities, including emotional content, are more useful. People also try to match actions to a tempo or need to invest effort into suppressing rhythmic alignment [30], yet we saw quicker completions with slower tempos. This points to a need for a deeper understanding of music emotional content and other properties that may influence behaviour and experience.

C. Lasting effects of emotional content of music

We observed slower completion times for the peaceful music condition when it was first. Further, we found an interaction effect with order and distance to fires, with powerful music resulting in farther distance when second. These interactions suggest peaceful music (while slowing down completion times overall) may have a lasting emotional and behavioural effect or encourage a certain play style that became entrenched. Over half of our participants reported heightened energy lasting up to several minutes after the powerful music condition. These results highlight that music choices are important as they may have effects that carry across even longer gaming sessions, even after changes in musical emotional content.

D. Musical fit to game design

Most previous studies have found tempo changes to affect behaviour and tension when using *classical* music [5], [15], [22]. Our study used electronic music and changed player behaviour and experience in similar ways to prior studies. This demonstrates that genre and instrumentation may not play a dominant role in affecting players compared to emotional labels describing a piece of music. Game composers can use this knowledge to focus on creating a specific player experience or behaviour based on the song's emotional properties rather than genre. Of course, testing with more songs is necessary to confirm if these findings hold to other electronic songs or more genres.

E. Study Limitations

We made choices to simplify the study design, which limits the generalizability of our study. We tested only one instance of powerful and peaceful music each, and each had other defining qualities according to the GEMS dataset, such as calmness, joyful activation, tension, wonder, etc [2], [33]. We also tested them in a simple game with a limited challenge that may not have presented an opportunity to observe the variety of effects that music and emotional content may have on a player or how they may interact with different games with different difficulties, atmospheres, gameplay, and more. A broad exploration of musical emotional content and gameplay is necessary to understand these initial results better.

VI. Conclusion

We demonstrated how musical emotional content can impact player emotion and risk-taking behaviour, in contrast to work that suggests music tempo is a good predictor. We found an increase in perceived tension for powerful music compared to peaceful music, without negatively impacting enjoyment. This was accompanied by decreased time taken per level, demonstrating that emotional content in music can influence player behaviour and experience. Game designers and composers can use this knowledge to better select background music that invokes targeted emotional experiences. Our work provides important new directions for building an understanding of the effects of music in video games.

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