

Influencing the Behavioral Responses of Players in an Interactive Narrative Game through Music and Arousal Congruency

Logan Parmeter
Department of Computer Science
Baylor University
Waco, Texas
Logan_Parmeter@baylor.edu

Matthew Fendt
Department of Computer Science
Baylor University
Waco, Texas
Matthew_Fendt@baylor.edu

Abstract—Music has been shown to influence the behavioral responses of individuals in real-world scenarios, but little research exists on the effects that music has on the in-game behaviors of video game players. A song can be rated in terms of the level of arousal, or emotional intensity, it incites, and this study explores how music of various arousal ratings can be used to influence players' choices in an interactive narrative role-playing game. We hypothesized that high-arousal music would influence players to exhibit avoidance behaviors in-game, and that low-arousal music would influence players to exhibit social behaviors. Experimentation showed that players were statistically significantly more likely to make avoidance behavior choices when high-arousal music was played. These findings are the first step into understanding how music can be used by game developers to influence player behaviors in interactive narrative games.

Index Terms—arousal congruency, avoidance behaviors, behavioral responses, music, narrative games, social behaviors

I. INTRODUCTION

With the growing popularity of video games in today's media, researchers continue to find new avenues of exploration into players' thought processes during gameplay. Understanding why players make the choices that they do in video game can not only increase a potential game's success on the competitive video game market, but can also aid game developers in creating games that increase player agency. Murray defines agency as "the satisfying power to take meaningful action and see the results of our decisions and choices" [1]. While agency is used to describe the sensation individuals feel while performing actions and interacting with their environment, this definition of agency has been applied by many researchers when studying player choice in video games. Murray's definition of agency is also adopted in this study in the interest of motivating a high sense of player agency while also influencing the choices that players make.

Existing research studying the effects of high and low-arousal music on the gameplay experience has focused primarily on its effects on player performance. However, little research has been done on the impact that music has in other

video game metrics, such as player choice. Game developers may wish to encourage players to make specific in-game choices without limiting the number of actions the player can take, which may result in a decreased sense of player agency as the player does not have enough options to partake in actions that feel truly meaningful. The potential need for developers to sway the choices of players in a certain direction during gameplay motivated us to ask if music of certain levels of arousal, based on Mehrabian and Russell's [2] arousal-valence model, can be used in video games to influence the choices that players make. Studies exist showing how music affected the social and avoidance behaviors in retail and restaurant environments [3] [4], and we therefore ask if the same effects can be generated in a video game when it comes to a player's choices. We hypothesize that, in narrative role-playing games, players can be influenced to make choices that exhibit social behaviors when presented with low-arousal music, and also be influenced to make choices that exhibit avoidance behaviors when presented with high-arousal music.

II. RESEARCH DEFINITIONS

A. Player Agency

Fendt *et al.* [5] conducted a study in which they attempted to give participants a perceived sense of agency in a game with a non-branching, linear storyline. To do this, participants were given immediate textual feedback each time they made a choice, and this was sufficient to give the illusion that player choice mattered in the game, even though the player's choices had no influence on the final outcome of the game's narrative. They found moderate support for their hypothesis that immediate textual feedback acknowledging a player's choice in a game with a non-branching storyline will create a similar sense of agency to a game with a branching story [5]. This model of creating agency is used in this study to create a sense of agency for participants.

B. Social and Avoidance Behaviors

Wirtz *et al.* [3] discuss other research that shows that highly-arousing environments "exceed the optimal level of

arousal for most people, thus resulting in a desire to flee or escape.” Conversely, under-arousing environments would be less than satisfactory in terms of the level of arousal individuals expected in a store environment, leading to a positive effect on approach behaviors in order to reach optimal arousal congruency with individual expectations. Much of this is based on Mehrabian and Russell’s [2] 1974 model that shows that environmental stimuli influence an individual’s pleasure and arousal in that environment, therefore influencing the approach and avoidance behaviors of that individual. In their study, Wirtz *et al.* used music tempo in part to denote the arousal of a simulated environment. High-tempo music was used to simulate a high-arousal environment, moderate-tempo for moderate-arousal, and slow-tempo for low-arousal. White noise was used for unpleasant conditions, and music was left otherwise unaltered for pleasant conditions. They found that in pleasant store environments, approach behaviors were maximized. Conversely, in unpleasant store environments, approach behaviors decreased with increasing stimulation. The researchers propose that “optimal stimulation is key to understanding consumers’ in-store behaviours” [3].

The above study is used as a large motivation for this experiment. Approach-avoidance behavioral responses in the previous study were measured across four categories, including exploring the store, spending more time in the store than planned, spending more money than planned, and being friendly towards strangers in the store [3]. For this experiment, generalizations of these four items were used to define *social behaviors* for this study:

social behaviors: actions that are exploratory or interactive in nature, such as engaging with other people or exploring/interacting with the environment

Conversely, *avoidance behaviors* are defined as:

avoidance behaviors: actions that refrain from interaction with other people or the environment, or exhibit a need to flee or escape from a situation

III. EXPERIMENTAL DESIGN

A. Music Selection

Music was selected from a dataset of 1000 songs compiled by Soleymani *et al.* [6], with each song annotated in terms of its arousal, indicating its emotional intensity. Each song is from the Free Music Archive, a database of creative commons music. Arousal for each song was annotated on a 9-point scale. Low-arousal songs were defined as those with an arousal rating that was less than 3, and high-arousal songs as those with an arousal greater than 6. These ranges separated the 9-point arousal scale into three equal parts, the high and low ranges as well as a middle arousal range for ratings greater than 3 and less than 6. Songs within the middle of the range were disregarded to create a greater polarization between the high and low arousal music. A total of 31 songs, 16 high-arousal and 15 low-arousal, were selected for the initial pilot study. Only the first 15 seconds of each song would be used so as

to not fatigue participants during the study. Because of this, songs were chosen based on this beginning section¹.

B. Experimental Design

A study was designed to measure the influence of musical arousal on the behavioral choices of players in a narrative role-playing game. Two hypotheses were evaluated in this experiment, and are listed with their corresponding null hypotheses:

H_1 : In an interactive narrative game, when an individual is presented with a choice accompanied by high-arousal music, the individual will make a choice that exhibits avoidance behaviors (escape, flee, avoiding interaction with others).

H_2 : In an interactive narrative game, when an individual is presented with a choice accompanied by low-arousal music, the individual will make a choice that exhibits social behaviors (exploratory, interactive).

We created a text-based, narrative role-playing game with a linear story to test our hypotheses. Participants played the role of a tourist in a new, unknown city engaging in a variety of activities over the course of a single day. Each of the activities and interactions for the tourist took place in eight individual scenarios, with each scenario having four unique behavioral choices from which the player could choose. Two of these choices we would classify as exhibiting avoidance behaviors, and the other two choices exhibit social behaviors. Participants could not return to previous scenarios or alter their past choices throughout the experiment.

A song was played immediately at the start of each scenario, with each of the four behavior choices hidden and unavailable to participants. After fifteen seconds, the song would fade out and the four options would be displayed simultaneously. We implemented this delay in each scenario to ensure that each participant would experience the musical treatment for the same amount of time as other participants in an effort to reduce any confounding effect that the exposure time to the music could have on our results. For any one participant, a particular song would only be presented once during the experiment. We attempted to create neutral scenarios that would not encourage specific choices when experienced without music to allow the music treatments to guide a participant’s choices.

The game² was developed using Twine 2 in the Sugarcube 2.21.0 format, which would compile the game into HTML and JavaScript that could be accessed and played via a web browser. Participants were students taking one of a selection of Computer Science courses at Baylor University during the Fall 2018 and Spring 2019 academic semesters, and the students represented a variety of different academic majors. For participating in the study, students were given five extra credit points on an exam, and they were given an alternative extra credit opportunity if they did not wish to partake in the

¹Examples of high-arousal and low-arousal music can be found at <https://tinyurl.com/HighArousal> and <https://tinyurl.com/LowArousal>, respectively

²The final game can be found at <https://tinyurl.com/y4yn3buy>

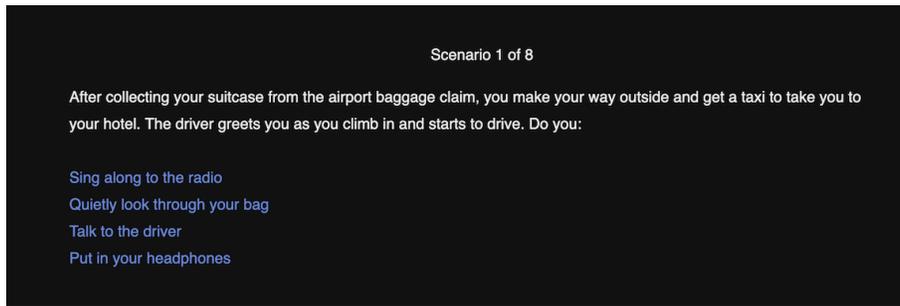


Fig. 1. Screenshot of first in-game scenario with all choice options presented.

study. Participants were given a hyperlink that would redirect them to a digital consent form. Upon clicking the link at the bottom of the consent form, indicating that they accept, participants were given a brief introduction to the game, explaining the in-game role they would be playing as well as a description of how each scenario would be presented.

Both the consent form and the introductory passage provided indication that music would be played throughout the experiment. After continuing from the introduction, participants were presented with the first scenario, and progressed through the game as stated above. Figure 1 shows a visualization of how the scenarios were presented. Following the final feedback passage for the eighth scenario, a conclusive passage was displayed thanking the participant for taking part in the study. Participants were given full disclosure about the purpose of the experiment at this point, which we chose not to fully disclose in the consent form to prevent swaying participants' choices.

IV. EXPERIMENTAL EVALUATION

This experiment was performed a total of three times, and data was collected for about one week during each iteration. The first two iterations of the experiment were pilot studies that were used to evaluate the efficacy of the game content and how it was presented. For the first pilot study, ten scenarios were originally presented to participants. After reviewing the data collected, we found that two of the scenarios appeared to be biased towards encouraging either avoidance or social behaviors. Because our goal with each scenario was to create a situation in which both avoidance and social behaviors were equally desirable, we chose to eliminate these two scenarios. Additionally, we initially ran the experiment with a total of 31 musical selections, with 15 low-arousal pieces and 16 high-arousal pieces. Of all 31 music pieces, ten were randomly chosen and ordered for each participant. After the data was collected for this experiment, we found that some music selections did not appear to influence participants' choices at all, so these selections were eliminated.

The second pilot study was run after making the changes previously stated from the first study. This study had a total of 25 songs that could be presented to participants (12 high-arousal and 13 low-arousal), and four from each category were randomly selected for each participant. After this experiment, we chose to further narrow down our music selection to four

high-arousal and four low-arousal music selections such that all participants in the final study would receive the same music treatments. These final music pieces were chosen by determining, for each category, which selections appeared to influence the specific type of behavior that we hypothesized: high-arousal encourages avoidance behaviors, low-arousal encourages social behaviors.

A total of 64 students participated in the final study ($N_F = 64$). A total of 512 individual data points were collected from the 64 participants, 8 points for each participant that denoted the scenario number, choice option, and song playing for each scenario. The data was separated into two categories corresponding to the type of music playing during a given scenario. Individual scenarios that played high-arousal music were placed in the "High" category, while the scenarios that played low-arousal music were placed in the "Low" category.

Using a Wilcoxon signed-rank test allowed for a comparison of the choices made by each participant across each of the above stated categories. This test does not require a population mean ($\mu = 0.5$), and because we cannot assume that the population of college students from which our data is sampled is normally distributed, we could not use a parametric statistical test, such as a matched-pairs t-test. Data pairs were generated for each participant for both the High and Low categories. A pair consisted of the total number of avoid choices made in that category (n_a) and the total number of social choices made in that category (n_s). As such, for any given data pair, the number of avoid choices nor the number of social choices could exceed 4 ($n_a \leq 4, n_s \leq 4$), and the total of summing the two values would always equal 4 ($n_a + n_s = 4$).

V. RESULTS

A Wilcoxon signed-rank test was performed on the data pairs for all 64 participants ($N_F = 64$) in the final study in both the High and Low categories. Within-pair differences in the High category were calculated as $n_a - n_s$, and differences in the Low category were calculated as $n_s - n_a$. For this test, the null hypothesis for both cases is that the median of the differences between the two populations, avoid and social, A and S , respectively, is zero ($H_{01} : median_{A-S} = 0, H_{02} : median_{S-A} = 0$).

For the High category, the observed mean difference m_{A-S} in avoid to social behaviors for the sample was 0.625, with

TABLE I
WILCOXON SIGNED-RANK RESULTS

Category	Sample Size (N_F)	Mean Difference (m_{A-S}, m_{S-A})	Test Statistic (T_H, T_L)	p-value
High	64	0.625	313.500	0.0146
Low	64	-0.7344	-397.00	0.9974

a test statistic T_H of 313.500, yielding a one-sided p-value of $p = 0.0146$. Because this p-value is less than 0.05, these findings are significant at the $\alpha = 0.05$ level. For this reason we reject H_{0_1} , as there is significant evidence to suggest that participants were more likely to exhibit avoidance behaviors when presented with high-arousal music.

For the Low category, the observed mean difference m_{S-A} in social to avoid behaviors for the sample was -0.7344 , with a test statistic T_L of -397.00 , which yielded a one-sided p-value of $p = 0.9974$. This p-value is not significant at the $\alpha = 0.05$ level, therefore we fail to reject H_{0_2} . There is not sufficient evidence to suggest that participants were more likely to choose social behavior choices when presented with low-arousal music. However, there is sufficient evidence to suggest that low-arousal music will not influence participants to exhibit social behaviors. A summary of the results of the Wilcoxon signed-rank test can be found in Table I.

VI. DISCUSSION AND FUTURE WORK

It is interesting that our results show a significant increase of avoidance behaviors when high-arousal music was presented, yet low-arousal music did not increase social behaviors. We postulate that this may have occurred for a few reasons.

First, there is the possibility that despite best efforts to eliminate bias toward particular behavior options within a given scenario, certain options were more desirable than others. For example, avoidance behaviors were exhibited by participants 86.8% of the time (33/38 occurrences) when high-arousal music was played during Scenario 3, whereas only 16.7% of participants (5/30 occurrences) exhibited avoidance behaviors when high-arousal music was played during Scenario 6.

Second, individual personalities could have had a greater impact on the choices that participants made than was accounted for in this study. Domínguez *et al.* showed that a player's narrative role had a significant impact on the choices made in a role-playing game [7]. In our study, it is likely that participants, who were told they would be playing themselves as a tourist, made choices that corresponded with actions they would take in real-world scenarios, resulting in the music having a diminished effect on their choices.

This study showed a significant increase in the number of avoidance behavior options chosen in a narrative game in the presence of high-arousal music. With these results, music has been shown to influence the behaviors and choices that players can make in a game, and these findings can be used to conduct future experiments in how music affects player choice. If this experiment were to be repeated, incorporating an initial experiment to evaluate the story content before presenting it to participants may help eliminate the potential biases we had

in our scenarios and choice options. We also acknowledge that the decision to play music for fifteen seconds during each scenario could impact the pacing of the game and potentially an individual's actions and emotions during gameplay, so the game could be altered in future iterations to record the amount of time a participant spends listening to the music during a given scenario, adding an additional metric for investigation. Creating separate treatment groups for the entirety of the game, and including a no-music treatment, could provide further insight into the complex nature of the relationships between players and game music.

VII. CONCLUSION

With the complexity of developing video games in the current era, developers must consider many factors, including player agency, when creating a compelling gameplay experience. Most of the research on music in video games has explored the roles that music can play within the game environment, the impacts it has on players' perception and gameplay experience, and the effects that it has on in-game performance metrics. This study presented a new perspective on how player choices and agency may be affected during an interactive narrative game, and we showed that high-arousal music significantly increased the avoidance behaviors exhibited by players. Although we failed to demonstrate that low-arousal music increased the social behaviors of participants, this study shows how music can be used in video games to influence in-game behaviors. Future studies can explore the effects on player choice of high and low-arousal music across game genres, and different measures of arousal in music.

REFERENCES

- [1] J. H. Murray, *Hamlet on the Holodeck: The Future of Narrative in Cyberspace*, NY: The Free Press, 1997, pp. 126.
- [2] A. Mehrabian and J. A. Russell, *An approach to environmental psychology*, Cambridge, MA: M.I.T. Press, 1974.
- [3] J. Wirtz, A. S. Mattila, and R. L. P. Tan, "The role of arousal congruency in influencing consumers' satisfaction evaluations and in-store behaviors," in *International Journal of Service Industry Management*, vol. 18, no. 1, Bingley: Emerald Group Publishing Limited, 2007, pp.6–24.
- [4] R. E. Milliman, "The influence of background music on the behavior of restaurant patrons," in *Journal of Consumer Research*, vol. 13, no. 2, Chicago, IL: The University of Chicago Press, 1986, pp.286–289.
- [5] M. W. Fendt, B. Harrison, S. G. Ware, R. E. Cardona-Rivera, and D. L. Roberts, "Achieving the Illusion of Agency," in *Interactive Storytelling Lecture Notes in Computer Science*, pp.114–125, 2012.
- [6] M. Soleymani, M. N. Caro, E. M. Schmidt, C.-Y. Sha, and Y.-H. Yang, "1000 songs for emotional analysis of music," in *Proceedings of the 2nd ACM international workshop on Crowdsourcing for multimedia - Crowd MM 13*, pp.1–6, 2013.
- [7] I. X. Domínguez, R. E. Cardona-Rivera, J. K. Vance, and D. L. Roberts, "The Mimesis Effect," *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems - CHI 16*, 2016.