Inducing Emotional Response in Interactive Media: A Pilot Study

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Abstract. Video games, entertainment, education, and training media have been developed for many years, and eliciting emotional experiences is an integral part of that process. Production and editing of the media in order to produce the desired emotional experiences can be expensive and cumbersome to media designers. This paper presents a pilot study intended to show that such experiences can be induced with after-the-fact audio-visual effects. As subjects of the user study, players are given the same virtual environment with two emotional states: fear, and peace. Over 70% of players report feeling the proper emotional response in both environmental states, revealing that it is indeed possible to induce emotional response with after-the-fact audio-visual effects, hinting at future possibilities for drag-and-drop emotional experience filters.

Keywords: Unity, video games, education, emotion, fear, peace

1 Introduction

1.1 Motivation

It has been a long-term goal of digital entertainment, education, and training media to be able to dynamically create experiences that are highly customizable on an individual user basis [7]. Inducing tailored, dynamic emotional responses is a critical component of that goal, yet there exists little by way of methodology for doing so [1]. Having a standardized methodology would allow designers of interactive experiences with a wide range of design and educational experience to easily tailor their products to particular subject matters. It gives them the ability to work on projects that are emotionally dynamic, meaning that they aren't rooted in providing a single static emotional experience, and allows them to save time by modifying existing work to provide new experiences. This study is a small step toward the capability of dynamically inducing specific feeling or psychological state in any interactive environment.

Prior work has shown that interactive media is indeed capable of effecting emotional state [16], and when combined with the motivating factors above, leads to the following hypothesis:

adfa, p. 1, 2011.

It is possible to induce emotional responses by making after-the-fact audio-video adjustments to video game content.

It is the goal of this pilot study to test the validity of this hypothesis and to gain further insight.

Educators could use this work to build better, more robust educational experiences that more effectively engage their students in the classroom. For example, multiple studies have shown that fear is capable of improving the effectiveness of health and safety media at producing behavioral changes in users [5, 9]. This work allows educational developers to create interactive experiences aimed at promoting health and safety that have purposefully tailored and optimized emotional experiences. They could do the same thing to educational environments centered on novels or historical events. And while the study is implemented strictly in the domain of video games, the underlying theory extends into all realms of entertainment, education, and training media.

1.2 The State of the Art

Games have implicit or explicit emotional requirements [1]. Despite this, there are no accepted methodologies for inducing various emotional responses. It is possible to install emotional responses as hard coded features in the game environment [2], but this kind of static development does little by way of empowering developers to create highly customized dynamic experiences. This flexibility would be useful across all digital entertainment, education, and training environments; however, it is especially useful in the MMORPG genre, where emotional response is tightly coupled with immersion, and it is critical that the right emotions are consistently induced [14]. In the FPS genre it has been shown that a correlation exists between emotion characteristics and user-specific preferences about games [8], indicating that different users have different emotional responses to the same content. The same may be true for other emotions, which means that dynamic emotional experience is not only convenient, but necessary for designing consistent educational experiences across a wide variety of users. Furthermore, evidence from the film industry suggests that emotional experiences in entertainment media have the capability of being universal across demographics [12].

In the gaming industry, the importance of lighting on the game experience is well understood [4]. Drawing on principles of cinematography lighting can be used to set mood and atmosphere, which are critical for inducing emotional engagement [3]. Color is also an essential tool. As far back as 1935, when the first feature film in Technicolor was released, it has been shown that color can be used in digital content for dramatic and emotional effectiveness [13]. Modern work on the effect of color on emotional response has shown that a relationship exists between saturation and brightness, and positive emotional response [15].

A recent study on the effect of audio on emotional response suggests that capturing the 'essence' of a sound is more important than the sound's fidelity. It is better to have a sound that matches our perception of the real sound, than to have a high quality recording of the actual sound itself [6]. Additionally, it has been shown that the integration of spatial sound in immersive virtual environments has a significant influence on the intensity of presence experienced by the user [11]. This is relevant because other work has shown that the degree to which a user is feeling present in a virtual environment can have an effect on the magnitude to which they experience fear [10].

2 Experimental Design

2.1 Unity

Unity[1] is a development environment for creating multiplatform 3D and 2D games and is used to create the testing environment for this experiment. It has been used to create many successful modern games such as: Kerbal Space Program, Cities Skylines, Firewatch, and many more[2].

The Unity platform has built-in tools which encompass multiple aspects of game design such as level and asset creation, backend scripting, and post processing image effects. The latter of those is used to great extent to tailor emotional states in this experiment. Unity is a convenient choice for developing the game environment in this study, as it provides a way to easily build up a prototype; however, nothing about this study is unique to Unity and the driving technologies are available in other game engines and design tools.

2.2 System

A high fidelity digital environment is created to host this experiment. The environment is an open-world, fantasy themed valley that users can navigate within and interact with.

It has two built in emotional states, fear and peace, that can be switched on and off programmatically. The environment in each of the two states can be seen in Figure 1 below. A simple narrative is provided to give users a sense of purpose, but there is no win condition. All that is required in the study is that users enter a state of immersion wherein the desired emotional affect can be induced.

Twenty-two users play out the narrative twice: first in one emotional state (randomly chosen), then followed by the other. Both experiences take five minutes to complete, and after each the user completes a small survey prompting them for their emotional responses. Overall, the entire process takes approximately twenty minutes.

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[1] Unity. https://unity3d.com/unity

[2] Unity Gallery. https://unity3d.com/showcase/gallery

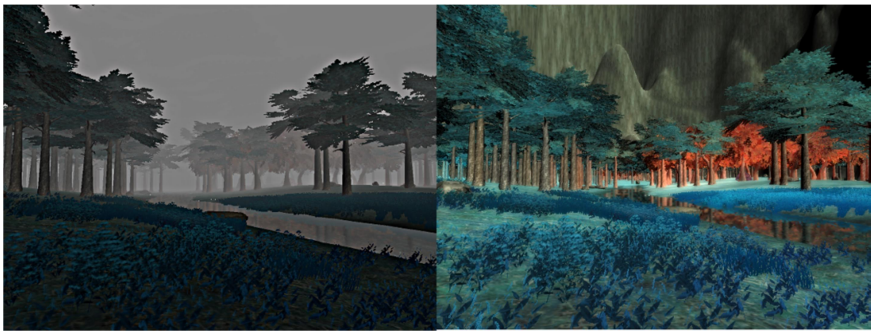

Fig. 1. Screenshots of the environment in the fear[3] state (left) and the peace[4] state (right). All visual differences are the result of post-processing image effects.

2.3 Fear and Peace

The fear and peace states present in this experiment are designed to induce opposing emotional responses. Both emotional states add a combination of after-the-fact audio-video effects to the base state of the scene. These effects are summarized in Table 1 below.

Peace mode amplifies lighting in the scene, and adds a bloom effect. It also changes the environment's background wildlife noises to simulate daytime forest wildlife, and adds a soothing mystical melody to the background.

The fear state makes changes opposite to those of peace mode. It darkens the scene, and instead of adding bloom it creates a layer of thick fog and amplifies contrast. It also causes ambient wildlife noises to be more indicative of a forest at night. It does this by lowering the frequency of the noises, and changing the kinds of noises to those of insects, owls, etc. Instead of having a mystical melody wrapping up the ambiance, the fear state has a persistent heart-beat underlay. It also introduces a motion-blur effect. The effect was added in conjunction with the heart beat sound to convey to the user a sense of danger, with the intention of stimulating the flight or fight response.

The video effects are all implemented using Unity Standard Assets[5], whereas the ambient audio effects are implemented using an asset called Interactive Audio: Enchanted Forest[6], which is purchased on the Unity Asset Store.

Table 1. Summary of fear and peace state audio-visual properties.

Fear State	Peace State
Darkened Scene[5]	Lightened Scene[5]

[3] Mystic Valley – Fear Mode. https://www.youtube.com/watch?v=dLDAMAXwTTk
[4] Mystic Valley – Peace Mode. https://www.youtube.com/watch?v=5YvTH6nMF00
[5] Unity Standard Assets. https://www.assetstore.unity3d.com/en/#!/content/32351

Increased Contrast[5]	Bloom Effect[5]
Fog Effect[5]	Daytime Animal Noises[6]
Blur Effect[5]	Background Melody[6]
Night Animal Noises[6]	
Background Heartbeat[7]	

2.4 Surveys

The player surveys are designed to prompt players to identify their emotional experiences. They are completely anonymous, and not a requirement for any assignment. Each survey consists of three questions that are directly tailored for emotional responses. The first is a free response question that asks: "Please describe any feelings or emotions that you felt during your experience." An example response can be seen below:

> *It felt creepier and more mysterious. [In] the first game [experience] I felt safe, but this time I thought there might be some threats waiting for me.*
>
> *-Anonymous Player*

The second question asks players to circle words that stand out to them based on their experience with the game. The words are arranged randomly on the survey, but for analytical purposes they are organized into five categories: fear, peace, secondary experiences, environmental, and unrelated with 2, 2, 3, 4, and 5 words in each category respectively.

The third question asks them to record any primary emotional experience they have, and the magnitude to which they feel it on a scale of 1 to 5. It should be noted that many of the words players chose to identify came from the table in question two: suggesting that there may be a biasing effect on the survey level for the second and third questions.

Twenty-two players participated in this study. They are all students from a collegiate level game design class, between the ages of 19 and 22, and the majority of them are majoring in Computer Science or Computer Engineering. Their programming experience is relatively uniform, but their prior experience playing video games is not. Some participants displayed quick aptitude with the environment's game mechanics, while others struggled. Participants were asked to play through the first and second experiences before completing the accompanying surveys (First & Comparison).

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[6] Interactive Audio. https://www.assetstore.unity3d.com/en/#!/content/18354

[7] Heartbeat Sound. http://www.soundsnap.com/heartbeat_thump_01_sfxbible_ss01947

3 Results

3.1 Qualitative

Results to the free response question are encoded in three categories based on each player's emotional reactions. If a proper emotionally descriptive word or a close synonym is used for a given experience, the response is placed into the first category. If the proper emotionally descriptive word or a close synonym is not used, yet some other emotionally descriptive word is used, then the response is placed into the second category. If no emotionally descriptive words are used then the response is placed into the third and final category. Three individuals (one of whom is a participant in the study) parse the surveys and encode each response. Of the twenty-two responses to both the fear and peace experiences, there is majority agreement across all encoders for 100% of responses in the first round, and 90.9% of responses in the second round. This method of encoding response data, and all following methods of interoperating results is designed before the survey is conducted.

After the first game experience, 77.3% of players reported a proper emotionally descriptive word or a close synonym, where 22.7% reported some other word, and 0% of players reported none. After the second experience 70.0% of players reported a proper emotionally descriptive word, where 25.0% reported some other word, and 5.0% reported none.

3.2 Quantitative

The analysis of question two is focused on participants circling (or not circling) at least one word in each category (Figure 2). The levels of significance from Fisher's exact test of two sample proportions and can be seen in Table 2.

Responses to the third question are grouped into three categories (fear, peace, and secondary) where their magnitudes are averaged, and then analyzed using Fisher's exact test of two sample proportions. The results can be seen in Figure 3 below, and the levels of significance from Fisher's test of two population proportions and average magnitudes can be found in Tables 3 and 4 respectively.

When observing the figures and tables below, it should be noted that R1 refers to a state in round 1 and R2 refers to a state in round 2. Also, each state denoted with R1 is paired in series with the opposite state denoted in R2. For example, the players who complete surveys in Fear R1 are the exact same who complete surveys for Peace R2 and visa-versa for Peace R1 and Fear R2. Any comparison amongst rounds is referring, in parallel, to the group that randomly started in one state and the group that randomly started in the other. For example, Fear R1 vs. Peace R1 is comparing the group of players that randomly start the first experience in the fear state with the other group of players that randomly start the first experience in the peace state.

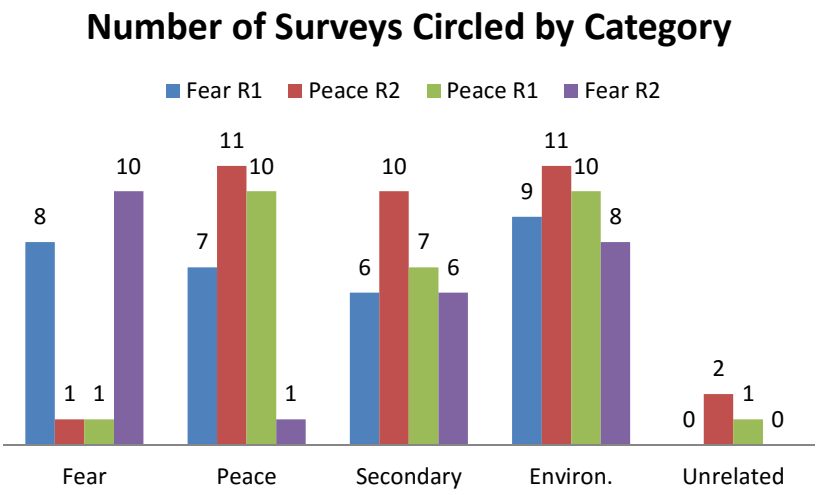

Fig. 2. The number of surveys that circled at least one word from each category in the circling survey question for each emotional state in both rounds. R1 and R2 indicate round one and round two respectively.

Table 2. Results from Fisher's exact test for two sample proportions on the circling survey question for each emotional state in both rounds. R1 and R2 indicate round one and round two respectively.

Category	Fear R1 vs. Peace R1	Peace R2 vs. Fear R2	Fear R1 vs. Peace R2	Peace R1 vs. Fear R2
Fear	0.026	0.000	0.009	0.001
Peace	0.399	0.010	0.581	0.007
Secondary	0.761	0.773	0.566	1.000
Environ.	0.785	1.000	1.000	1.000
Unrelated	0.492	0.506	0.495	1.000

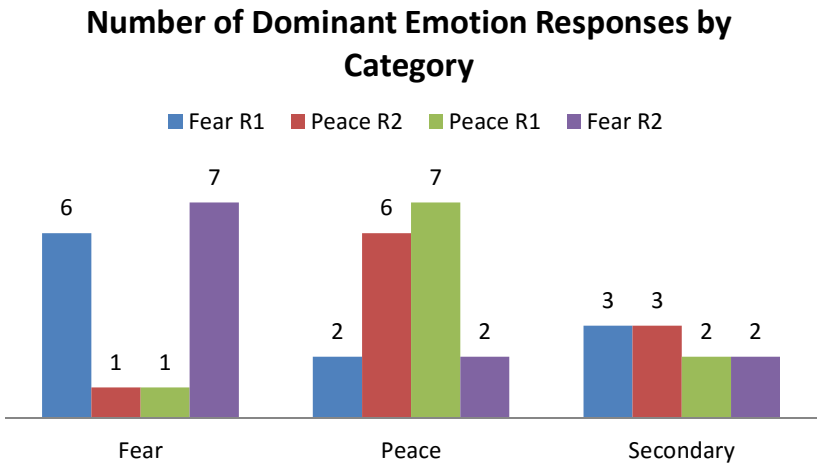

Fig. 3. The number of surveys that state a dominant emotion that belongs to one of three categories (fear, peace, and secondary) for each emotional state in both rounds. R1 and R2 indicate round 1 and round 2 respectively.

Table 3. The results of Fisher's exact test of two population proportions on the dominant emotion and magnitude survey question. R1 and R2 indicate round 1 and round 2 respectively.

Category	Fear R1 vs. Peace R1	Peace R2 vs. Fear R2	Fear R1 vs. Peace R2	Peace R1 vs. Fear R2
Fear	0.063	0.024	0.063	0.024
Peace	0.030	0.082	0.080	0.030
Secondary	1.000	0.635	1.000	1.000

Table 4. The average magnitudes of responses to the dominant emotion and magnitude survey question. Results are on a scale of 1 to 5 with 5 being the greatest. R1 and R2 indicate round 1 and round 2 respectively.

Category	Fear R1 Avg.	Peace R2 Avg.	Peace R1 Avg.	Fear R2 Avg.
Fear	4.00	4.00	3.00	3.71
Peace	4.00	4.17	4.14	5.00
Secondary	3.33	3.33	4.00	3.00

4 Conclusion

4.1 Discussion

The results from the qualitative survey question reveal that a significant majority of players experienced the proper emotion in both their first and second experiences with

the game. This serves as an initial examination that the game experiences are valid, as this question comes before the other two, and is unbiased by any prior verbiage.

The results from the second (circle) question are more interesting. There is a statistically significant difference between the proportions of surveys that have fear related words circled in both the first and second game experiences; yet there is only a significant difference for peace words in the second experience. When comparing player responses of each experience in the first round, to the opposite experience in the second, the exact same pattern of significance appears. Again there are significant differences in the proportion of fear words circled in both cases, but only with words associated with peace in the case that the peace state was the first state experienced. All of this suggests that there may be some kind of contrasting effect present in the system as players are shown to be unlikely to circle words related to their first experience on their survey for the second experience. As to the discrepancies in the proportions of peace words circled when fear comes first, it is possible that there are some baseline emotional experiences in the system. Perhaps it is inherently peaceful to be in a forest or listen to a heartbeat, as some players remarked on the soothing effect of the forest or heartbeat in their qualitative responses. There are no significant differences among environmental, secondary, or unrelated word proportions in any of the parallel or series test cases.

As for the dominant emotion and magnitude question, there is a significant difference between the proportion of players who used fear or peace words as the dominant emotion in both game states and in the first and second rounds. The larger proportion matches the proper category in all cases. There are also significant differences between each experience in the first round and the corresponding opposing experiences in the second round. The average magnitudes are appropriately larger in both states of the first game experience, but inappropriate in both states for the second experience; however, this can be heavily discounted by the fact that the vast majority of participants report the proper dominant feeling for both cases. Namely, a couple of participants report the unexpected feeling with great magnitudes, but many more reported the correct feeling with a variety of magnitudes. There are no significant differences among secondary emotion proportions in any of the test cases.

Overall, the results from all three questions reveal that after-the-fact audio-visual effects can be utilized to induce emotional response in users, and that some of the effects listed in Table 1 are valid sets of effects for inducing the emotional responses of fear and peace. While the results of this study are limited to the domain of video games, one could theorize that the conclusion would be the same for any kind of entertainment media.

4.2 Future Work

The audio-visual effects that are tested in this study are highly subjective. It remains to be seen which are most effective at inducing affectional responses, and which are ambiguous. Qualitative results of the pilot study suggest that some effects, such as the heartbeat sound, need to be tailored or removed altogether. The study also needs to extend to other game environments to validate to the assumption that the

same methodologies would apply in other contexts. In this case, any environment specific effects also need be removed or replaced. It would be interesting to study emotional responses besides fear and peace. If positive results were obtained from an experiment with a set of non-contrasting emotions, it would strongly support this experiment's hypothesis.

Some of the results indicate that there may be a baseline emotional experience present in the system with no after-the-fact audio visual effects applied. While the study in its current state reveals some interesting things about differences in emotional states across experiences, it will be impossible to quantify any measure of absolute emotional effect without first understanding this baseline.

As the study has shown that audio-visual effects can easily induce emotional responses in video games, this work will be translated into Unity asset packages and made available on the Unity asset store. This will allow educators developing in Unity to easily, and confidently tailor their environments to their specific set of users and subject matters.

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