
**Tic Tac Toe Game With Virtual Monster:
The Ability To Elicit Emotional
Response In Human**

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Abstract

Our society has been influenced by video games for more than 30 years. Are these video games able to elicit emotional response in human players just like the way other human beings do? To investigate this question, we design a Tic Tac Toe game using Unity with a virtual character that plays against the user, and to compare emotional responses when the human player is playing with other human and when playing with virtual character.

Introduction

Virtual games have a ubiquitous role in our lives for people from all ages, with 97% playing for at least one hour per day in the United States [1]. Some people play easy and simple virtual games on phones, while some people play more complicated and harder virtual

games on larger screens. When we play these virtual games, we are interacted with the virtual characters that are created by developers.

There are already a large amount of researches in the filed that demonstrated how the virtual games are able to influence the players. The majority of these researches focused on the negative impact of the virtual games, including the potential harm related to violence, aggression, addiction, and depression [1, 2]. Most of people have the concern that virtual games may more or less contain some violent elements, thus most of the studies are based on the emotional impact that violent video games have on the players.

However, there are two questions that should be raised here:

- 1: Are virtual games able to influence the emotional state of the player when he or she is playing the game?
- 2: Does the impact that the virtual games exert to players mostly negative, positive, or balanced?

In order to investigate these two questions, we created a very straightforward virtual game that is simple to play, and we used this game as a tool to detect the change of emotional state the player experienced (see Figure 1). Most of virtual games that people regularly play contain multiple emotional elements, and they require some gaming techniques and skills. We wanted to create a more simple virtual game that is able to

detect whether there is an emotional change directly. The emotion can be detected by the facial expressions of a person, therefore we added the feature to detect the change of facial expressions in our game.

The contributions of our study are:

1. Virtual games are able to change the player's emotional state just like other humans do to some extent.
2. We developed the basic virtual game that can detect the change of facial expressions of the player, the future studies can be based on our game and adding different features to it.

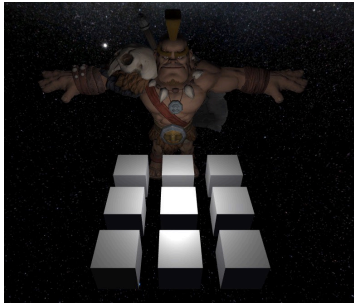


Figure 1: The start gaming setting of Tic Tac Toe. The participant is at his or her first-person perspective, and plays the game against the virtual monster.

Related Work

Previous studies are mostly focused on the research of the violent virtual games. Analyses reveal that virtual games contained violent content increase physiological arousal and aggression-related thoughts and feelings [2, 3]. However, virtual games are not all violent themed, so we aim to value a balanced perspective. The first step of this is to find out whether the virtual games can influence our emotions, if so, how do they influence us and in what degree they influence us.

There were studies demonstrated that if the player is playing the game with a first-person perspective and with a storyline, he or she enjoys the game more, because it helps involve them in the game, and makes them feel more immersed in the virtual environment and keeps them aroused [4]. Therefore, we decided to add a virtual character in our Tic Tac Toe game to play

against the user, and we let the user play the game at a first-person perspective (see Figure 1). If there is a virtual character sitting at the opposite of the user, the user should be more involved in the game, feeling like he or she is playing with someone alive with emotions.

Instead of studying how the games that contain violent content influence us, we just study the change of facial expressions and emotions without considering whether it is negative or positive. The only thing we focused in this study was to find out if there is a difference of emotional changes between the process that human is playing with another human, and human is playing with virtual character.

Methodology

We designed a Tic Tac Toe Game using Unity that let the human player to play against a virtual monster that we created.

The reasons that we chose the Tic Tac Toe game are:

1. The game is not a "too simple" game so that the participant is able to have fun with it.
2. The participant and the virtual monster are taking turns to play the game, so it is a highly interactive game.
3. There is a relatively logical algorithm of the Tic Tac Toe game, so the virtual monster is not going to just randomly mark his cell. Instead, he will use logic to decide the best cell to mark.

We have two conditions:

Condition 1 (Control Condition): Let the human player plays the Tic Tac Toe game with another human.

Condition 2: Let the human player plays the Tic Tac Toe game with virtual monster.

We did tests on five participants, three males and two females, all from University of San Francisco, aged from 20 to 22.

We designed two tests for each participant. The participant first played a Tic Tac Toe game with another human, using pencil to draw markers on the game board showed on the paper ("X" for participant and "O" for the other human). The person who succeeds in playing three of his or her markers in a horizontal, vertical, or diagonal row wins the game. After that, the participant played a Tic Tac Toe game with virtual monster that we created in Unity. The participant clicked the cells he or she wanted to mark, and the cell would be marked as red. The cells of the virtual Monster would be marked as blue (See Figure 2 and 3). When the participant was playing under these two different conditions, the facial expressions of the participant was detected automatically by Unity (See Figure 4 and 6).

After the two rounds of game, the participant was given a questionnaire that asked for information about how did him or her feel during the games under two different conditions. Our questionnaire was presented in Likert scales on a scale of 1-5. The information from the questionnaire was regarded as a reference that was used to compare with the data that we got from the facial expressions detection.

We choose several different facial expressions and emotions to detect in our study: smile, brow raise, mouth open, attention, joy, sadness, and anger.

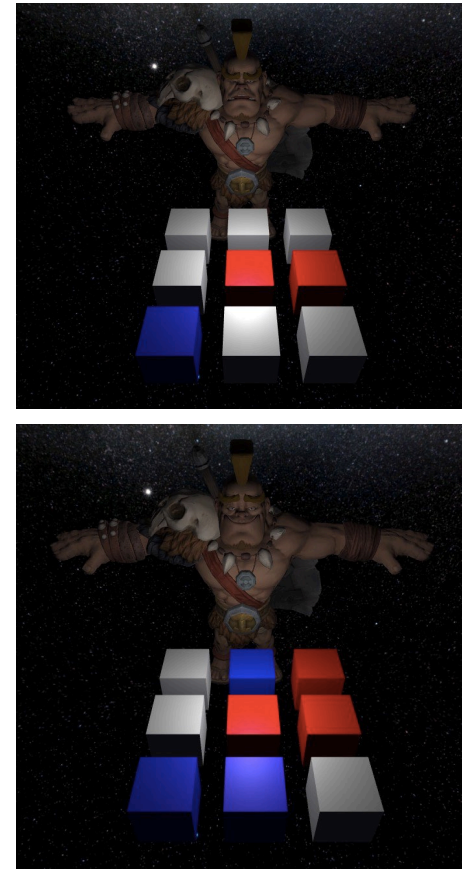


Figure 2 and 3: The gaming setting with user marks blue and virtual monster marks red.

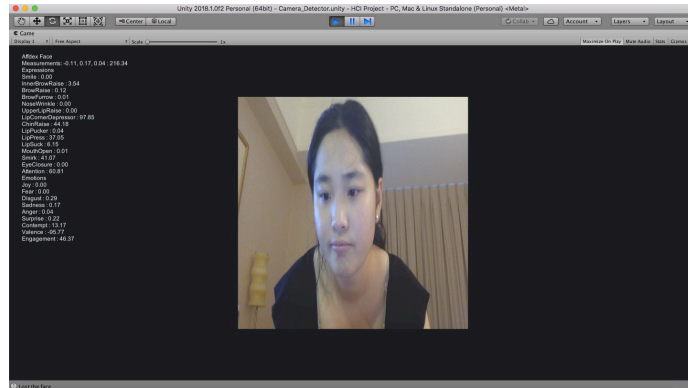


Figure 4: The interface of the facial expression detecting. The column on the left showed all data that were detected by Unity.

Result

We detected the data in every 10 seconds (See Figure 6), and we detected seven different categories of emotional states and facial expressions. We carried a t-test on each set of data for each participant. For example, we compared the data of smile under two conditions for the participant shown in Figure 5. The p-value is 0.1158 (>0.05), which does not show a statistically significant difference, meaning that the emotion smile of this participant under two testing conditions are mostly similar.

After carrying out all the tests on all the data, we got the result that is showed in Table 1.

The smile and angry emotions have statistically significant difference (< 0.05), while other emotions and facial expressions are not statistically significant different. This result showed that when the participants were playing under two different conditions, their emotional and facial expressional changes are mostly similar, meaning that the Tic Tac Toe game with a virtual monster was able to exert emotional impact on the human player mostly like the way a human could exert emotional impact on another human.

Also, if we looked at the data change showed in Figure 5, it was clear that there was a continuing change of states for each category of emotions and facial

	Human vs Human						
	Smile	BrowRaise	MouthOpen	Attention	Joy	Sadness	Anger
0-10	99.6	18.88	12.67	99.78	87.89	0.02	0.04
10-20	96.45	34.67	23.34	99.56	84.55	0.05	0.07
21-30	99.34	32.56	23.56	93.56	86.34	0.09	0.05
31-40	88.67	56.23	34.67	99.34	89.02	0.03	1.87
41-50	89.96	51.09	45.23	98.76	89.43	4.57	2.33
51-60	82.34	53.45	53.45	96.45	87.31	6.98	1.22
61-70	85.23	67.12	58.98	87.56	85.79	5.89	2.45
	Human vs Virtual Monster						
0-10	98.21	23.45	9.98	95.9	76.45	0.01	0.02
10-20	97.78	22.44	12.23	99.54	88.32	0.01	0.03
21-30	98.9	12.34	13.23	96.89	76.98	0.02	0.04
31-40	94.87	19.98	24.23	89.9	82.96	0.01	0
41-50	97.21	18.85	12.23	96.67	92.34	0.01	0
51-60	92.34	19.96	11.2	93.45	94.56	0	0
61-70	99.65	21.23	10.56	92.12	91.23	0	0

Figure 5: One example of data we detected in both conditions: human vs human and human vs virtual monster. There are seven categories of emotional states and facial expressions.

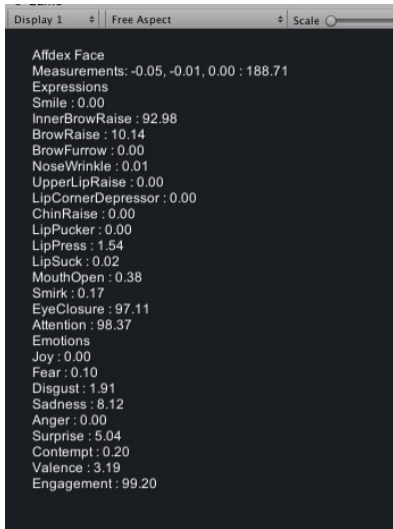


Figure 6: The column of data that were detecting by Unity when the participant was playing the game.

expressions. The player's emotions was changing during the process of gaming.

From the result of the questionnaire part, most of the participants stated that they felt mostly the same when they played with another human player and when they played with the virtual monster, and they felt sense of achievement or sense of loss when they won or lost the game just like the way when they played with human player. Some participants thought that there was a little bit boring when playing the game because the Tic Tac Toe game was too simple. Most of participants believed that they acted more relaxed when they played with virtual monster than another human, and if they could play this game when they were under negative emotional state, there was a possibility that the virtual monster could cheer them up. One interesting thing we found out was that although the participants' emotion was influenced by the virtual monster, they said that they could not feel the emotion of the virtual monster very well.

Discussion

Our study only focused on the simple virtual game, which did not contain complicated gaming features. Our next step is to add more features to the virtual monster and detect the change of facial expressions and emotions under that condition. We should get a more comprehensive data result.

Emotional State / Facial Expression	p-value
Smile	0.0347
Brow Raise	0.3439
Mouth Open	0.1074
Attention	0.1130
Joy	0.3909
Sadness	0.1267
Angry	0.0196

Table 1: All the p-values of our study using data from five participants after carrying the t-test on each emotional state or facial expression.

The result of our study showed that most participants felt the game a little bit too boring because the Tic Tac Toe was too simple. If we need to iterate our study, we are going to upgrade our game to a more interesting one for the players.

The result also showed that even though the participants could not feel the emotion of the virtual monster, the virtual monster was still able to exert emotional impact on them. For our next iteration of the study, if we could find a way to make the facial expression of the virtual monster more vivid, the emotional impact he generated on the human

participant should be more obvious. This could probably be achieved by adding more sounds, more feeling of interaction, and more layers of facial expressions to the virtual monster.

Conclusion and Future Works

The present study offers several important outcomes. Based on the detection and analysis of seven categories of emotions and facial expressions, the virtual games are able to influence the players' emotional states mostly like how a human can influence another human. Most of participants in this study felt no significant difference when they played against another human and played against the virtual monster. The facial expressions of the participants, such as the degree of mouth opening and brow raising, were continuously changing under both conditions.

The game with virtual monster that was used in this study was a starting point for more complicated virtual gaming design. For future works, our simple Tic Tac Toe game with virtual monster can be iterated by adding more layers of features and virtual elements. By doing these, there is a possibility for us to find out whether the emotional impact the virtual games exert on us are mostly positive, negative, or balanced.

Acknowledgements

We thank all the volunteers for being participants in our study, and thank our professor and teaching assistant for helpful ideas and comments. Special thank to University of San Francisco.

References

1. Granic, I., Lobel, A., & Engels, R. C. M. E. The benefits of playing video games. 2014. *American Psychologist*, 69(1), 66-78. <http://psycnet.apa.org/record/2013-42122-001>.
2. Christopher John Ferguson. The Good, The Bad and the Ugly: A Meta-analytic Review of Positive and Negative Effects of Violent Video Games. 2007. *Psychiatric Quarterly*. <https://link.springer.com/article/10.1007/s11126-007-9056-9>.
3. Craig A. Anderson, Brad J. Bushman. Effects of Violent Video Games on Aggressive Behavior, Aggressive Cognition, Aggressive Affect, Physiological Arousal, and Prosocial Behavior: A Meta-Analytic Review of the Scientific Literature. *Association for Psychological Science*. 2001. <http://journals.sagepub.com/doi/abs/10.1111/1467-9280.00366>.
4. Edward F. Schneider, Annie Lang, Mija Shin, Samuel D. Bradley. Death with a Story: How Story Impacts Emotional, Motivational, and Physiological Responses to First-Person Shooter Video Games. *Human Communication Research*. 2004. <https://academic.oup.com/hcr/article-abstract/30/3/361/4331516>.