



5-12-2015

Stress Relieving Video Games: Creating a Game for the Purpose of Stress Relief and Analyzing Its Effectiveness

Nicole Mercer

Follow this and additional works at: http://vc.bridgew.edu/honors_proj

 Part of the [Computer Sciences Commons](#)

Recommended Citation

Mercer, Nicole. (2015). Stress Relieving Video Games: Creating a Game for the Purpose of Stress Relief and Analyzing Its Effectiveness. In *BSU Honors Program Theses and Projects*. Item 108. Available at: http://vc.bridgew.edu/honors_proj/108
Copyright © 2015 Nicole Mercer

This item is available as part of Virtual Commons, the open-access institutional repository of Bridgewater State University, Bridgewater, Massachusetts.

Stress Relieving Video Games: Creating a Game for
the Purpose of Stress Relief and Analyzing Its Effectiveness

Nicole Mercer

Submitted in Partial Completion of the
Requirements for Commonwealth Honors in Computer Science

Bridgewater State University

May 12, 2015

Dr. John Santore, Thesis Director
Dr. Seikyung Jung, Committee Member
Dr. Laura Gross, Committee Member

Stress Relieving Video Games: Creating a Game for
the Purpose of Stress Relief and Analyzing Its Effectiveness

Nicole Mercer

Bridgewater State University

Abstract

Stress is an inevitable part of human life that can have both physical and mental repercussions if left to simmer. The purpose of this project was to make a simple game-like application that will be at least as effective at relieving stress as other games referenced in my research below. To accomplish this, I took common ideas known to relieve stress and designed a game that incorporates them, programming the game in Java. Then, to test the effectiveness of the created game, I had several subjects fill out a questionnaire about their stress levels and took their blood pressure. One group was tasked with playing the game I had specifically designed to de-stress them, the second group did a relaxing breathing exercise, and a third group played Tetris. The groups were then compared by their differences in stress levels. It is my hope that this experiment will provide insight into what helps relieve stress. As stress is a common part of people's lives, finding a simple way to remove such an ailment would be beneficial to a great number of people. Although the created game was not as successful relieving stress as the researched games, the experiment provided insight into changes that could be made to make a game more effective at relieving stress.

Stress Relieving Video Games: Creating a Game for the Purpose of Stress Relief and Analyzing Its Effectiveness

Stress is a natural part of life. People react to any change, big or small, with some degree of stress. However, when stress goes on for too long, its initially beneficial effects can become damaging to the mind and body. According to the National Institute of Mental Health, stress can affect one's immune, digestive, excretory and reproductive systems and prolonged stress "may lead to serious health problems, such as heart disease, high blood pressure, diabetes, depression, anxiety disorder, and other illnesses" (National Institute of Mental Health). Stress is an inevitable part of life, so finding a simple method of treating it would be incredibly beneficial to the health and well-being of many people.

When searching for a far reaching solution to stress, casual video games come quickly to mind. According to a study conducted by the Pew Research Center, 90% of American adults own smart phones (Pew Research Center, 2014). Simple, but addicting games on phones and computers are very popular, with 2013's most played casual game, Candy Crush Saga, clocking a massive 66 million daily users (Woollaston, 2013). The Casual Games Association reports an audience of 200 million people worldwide play casual games on phones, computers and video game consoles (Casual Games Association). These casual video games have a very large audience who can access the games quickly and easily from nearly any location. Millions of people have mobile devices that could be used to access a simple, stress relieving game. If a simple game can be made to decrease stress in people with different ages, genders and backgrounds, then it could be utilized in a way that is beneficial to many people and their health.

Related Works

There have been several studies in the cognitive science field showing that video games have the potential to affect the human brain. One of these studied the effects of a game of Tetris on PTSD patients. By playing Tetris after viewing traumatic material, the participants experienced significantly fewer flashbacks to the material than the control group (Holmes, et al., 2009). In this study, participants were shown a video of traumatic imagery. After a thirty minute break, one group played Tetris for ten minutes and the other group was assigned no task. The flashbacks of both groups were monitored for one week. The results of the study revealed that the group that played Tetris had significantly fewer unwanted flashbacks to the traumatic footage. The Tetris group was still able to remember the footage when they consciously tried to remember it, meaning their memory of the event was not affected (Holmes, et al., 2009). This study provides insight into ways that video games can affect the people, showing that playing Tetris for a short amount of time can prevent involuntary flashbacks. While this study is not specifically studying stress, it does study the positive effects of video games on the people who play them.

Video games can also be used to train people in exercises used to manage stress. When a group of military personnel utilized an altered video game to train themselves in a breathing exercise, the group that used the game to train learned the technique better than a control group and responded more calmly to a practice simulation (Bernier, 2011). In Bernier's study, soldiers were trained to recognize and combat stress using a video game. After being trained in tactical breathing and stress management techniques, the soldiers were divided into a control group and a study group. The study group played a modified version of the game Left 4 Dead, a first-person shooter with elements of horror. The game was modified to incorporate biological feedback

from the soldiers playing, changing the color of the screen and playing the sound of a heart beat when the player's heart rate or sweat production increased. A coach was present during the half hour of game play to assist the soldier in learning and applying their stress management skills. Several days later, the two groups took part in a live action simulation where they had to provide first aid to a live actor in a stressful situation. The soldiers who had taken part in the video game training were less stressed by the live action simulation than the control group (Bernier, 2011). This study shows the connection between learning a skill and video games. A video game could be designed to train the player in stress management techniques by simulating stressful situations and teaching the player methods to control their stress. Due to the way this study was performed, it cannot be established with certainty that the soldiers would have learned the skills to overcome battlefield stress from the game if they did not also have the coach present. More research would have to be done on how effective games are on their own as opposed to pairing games effectively with human teachers. It is also important to note the difference between the intent of this study and this author's study. The intention of Bernier's study was to prepare individuals to control their stress by placing them in a simulation of a stressful situation. The author's study is instead trying to remove stress which is already present.

In a study by O'Brien (2009), an experiment was performed to determine how effective casual video games were in improving the moods and decreasing the stress of the people in the experiment. Unlike Bernier's study which used *Left 4 Dead*, an intense action game, O'Brien's study used simple, repetitive puzzle games *Bejeweled 2*, *Bookworm Adventures*, and *Peggle*. Members of the experiment placed in the control group performed a simple task on the internet, while members in the test group chose one of the three games to play for twenty minutes. The results of the study showed that playing casual games did effect the players by positively

improving their moods. The study also found that different games would affect the players in different ways. Bejeweled 2 had the most profound and noticeable improvement in mood. The study also looked at a decrease in the tension of the players. In this respect, Peggle was the most effective at reducing tension. In a self-reporting survey taken before and after the game play, participants reported being less depressed and less angry after playing the games. O'Brien's study shows how video games can affect people's brains while playing them, improving the mood of the people who play them. The results of the study also emphasize that different games will affect players differently, while still improving mood and reducing stress. This implies that with more research into the mechanics allowing certain games achieve their effects, a game could be developed to specifically target areas of the brain that positively affect the players of the game. O'Brien's study is most similar to the author's in terms of the style of game which was played. O'Brien's study focused on casual games and how effective they were at eliminating stress in their players, which is the same intention as the author's study. It differs from the author's study in how the data was collected. O'Brien's study used several, self-reporting surveys to gather data from participants, while the author's study involved both surveys and the participants' heart rates and blood pressures. With the addition of the blood pressure readings, the author's study has more reliable data than can be gathered from a self-reporting survey alone. O'Brien's study also involved a different type of casual game than the game that was created for the author's research.

Dopamine is a chemical in the human body which, among other things, plays a major role in a person's mood. A lack of dopamine is connected to depression (Scientific American Blog Network, 2012). A study by Koeppe (1998) looked at dopamine production in participants playing a video game. The in-depth study took eight participants and scanned their brains'

activities before, during, and after playing a simple video game. The game is described in the study as putting the player in control of a tank moving to the right on the screen. The player's objective was to collect all of the flags in a level while destroying enemy tanks. The participants were also rewarded with a monetary prize every time they completed a level. The results of the study showed an increase in dopamine production in the participants while playing the video game. This study shows that playing a simple game can increase the production of a mood-boosting brain chemical, directly tying playing video games to the improvement of mood. The study has a small pool of participants and one has to wonder if the monetary reward had any effect on the player's mood during the game play. More research would have to be done on a larger pool of people in order to truly understand what effect video games have on dopamine production and what it is about those games improves the production. If the aspect of a game that increases dopamine production could be determined, games could be designed with that specific purpose in mind to reduce the stress of players by directly improving their moods. Koepp's study was greatly different from this author's study in terms of the data collected. Koepp's study was directly about chemicals in the brain and body of the participants, focusing on how much dopamine was produced while the participants played a game.

A study in the *Journal of Science* (2014), hundreds of volunteers in several different groups were asked to either think about whatever they wanted or to think about a specific prompt. The participants were asked to sit in a room without any distractions for six to fifteen minutes and think about whatever they were assigned to think about. Some participants were asked to do the experiment in a sparse room provided by the test givers, while others were allowed to do the experiment from their homes. More than half of the participants in these groups were unhappy with their experience. Another group was brought into a room with a

device that would allow them to shock themselves. All participants reported that they would pay money rather than be shocked again, but when left alone with their thoughts 67% of men and 25% of women shocked themselves with the device (Wilson, 2014). This shows that men were particularly prone to trying to distract themselves in any way possible when left to their own thoughts. Many of the participants in Wilson's study were undergraduate students, implying that young men get bored very quickly when they are left to do nothing for even relatively short periods of time (Wilson, 2014). The study being performed for this thesis involved leaving participants with their thoughts in two of the three activities. The Scavenger Hunt game was designed in a way that causes the player to have to wait for time to pass. Other participants were assigned to do a relaxing breathing exercise where they were told to perform the exercise in silence for ten minutes. The results of Wilson's study are applicable to the results of this study.

In a study by Hébert et. al. in *Life Sciences* (2005), participants' reactions to the background music in video games was studied. Specifically, the experiment studied participant's level of cortisol, a hormone connected to stress, when exposed to the music in a video game. Participants were assigned to play a game either silently or with the music on. The experimenters took four saliva samples from the participants at different times over the course of their game-play: after practicing, after ten minutes of playing, fifteen minutes after they stopped playing, and thirty minutes after they stopped playing. The group that played with music was found to have much higher cortisol levels than the participants in the silent group, indicating that the music made the participants less stressed. This research was taken into account when the author was designing the experiment. It was decided that the experiment should be performed without sound for all groups of participants if music was already shown to affect people's stress

levels. This kept the author's results focused on the success of the game-play as a means of stress relief.

The biggest difference between all of these studies and the author's experiment is the game itself. It is unclear whether the game in Koepp's study was created by the researchers, but the games in O'Brien and Bernier's studies were all games that had been created by someone other than the researchers. This means that the games were not created with the purpose to relieve stress; the authors of the studies simply saw them as good candidates for their experiments. In this study, the game was created by the author with the intention of testing to see how effective it would be in reducing stress. The variety of games being tested also varies greatly between the referenced experiments and the author's own. Koepp's game sounds like a side-scrolling action game, O'Brien's games are casual puzzle games, Bernier's Left 4 Dead is a first-person horror-themed shooter, and the game created for the author's thesis is a hidden object puzzle game. The author's game lines up best with the casual games from O'Brien's study, but those puzzle games are more action based than the hidden object genre of games.

Description/Discussion of Game

The game the author created with the intention of relieving stress in the player is called "Scavenger Hunt." In this game, players are shown pictures of an outdoor setting like a forest or a park and given a list of animals to find. When the game is started, players are presented with a screen that shows the games title and a menu which allows the players to proceed to the game, view a credits screen, or quit the game. If the player selects the option to quit the game, the game will ask the player to confirm this decision. The game can be exited at any time by closing the window. When the player chooses the option to proceed to the game, they are taken to another menu screen with two options. The player may navigate back to the previous menu or may proceed to a level selection menu.

When the player chooses to go to the level selection menu they are shown a small picture of what the level looks like, along with the number of the level ("Level 1", "Level 2", etc). The player may press a button next to the level image to begin that level. There is also a button on the bottom right of the level selection screen allowing the player to move to the next page of level options. There are a total of five levels to choose from. A button in the bottom left of the level selection screen allows the player to return to the title screen menu.

After selecting a level, the player is taken to a game play window showing the background scene of the level they selected. Below the image is a list of animals that the player will have to try and locate in order to win the game. A button in the bottom right corner with a picture of a pair of binoculars can be clicked which will zoom in on the image, allowing the player to look closely at parts of the image. When clicked a second time, the binoculars button will zoom the view of the image back out to the initial, full image. This allows the player to toggle between the full and zoomed-in views of the image at will. Each level lasts about four

minutes and the passage of time is indicated by a watch in the lower right of the screen and by occasional lighting changes. A button in the top right corner of the window allows the player to pause the game. When paused, the game removes the game scene and replaces it with a screen explaining that the game is paused and showing the player how many items on the list they have already located. At the top right of the pause screen, a play button can be clicked to resume the game play.

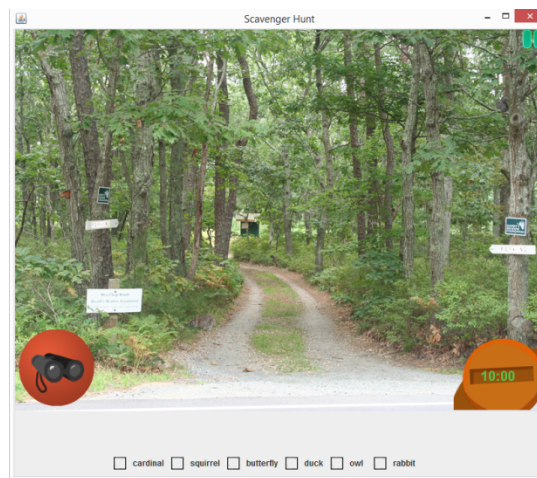


Fig 1: The first level of Scavenger Hunt, zoomed out.

Time is depicted to the player in the form of hours, with the game duration spanning from 10:00AM to 9:00PM. The watch only depicts time passing in hours rather than in minutes, so that the player does not feel pressured by a rapidly updating timer. The images in the game will start off depicting a scene in daylight. As time passes and the game's clock reaches five o' clock, the lighting in the image will change to depict sunset, and then, at six o' clock, will change again to a nighttime scene. The background image does not change, except for these lighting changes. The animals in the scene will change depending on the time of the virtual day. Some animals will be present in the scene for the entire duration of the level, while other will only appear in a

certain lighting situation. For example, a bat is well known to be nocturnal and therefore appears in the scene only when the lighting of the scene depicts nighttime. The concept of animals only appearing at certain times was communicated to participants through verbal instructions before they played the game. As the player locates animals in the scene, they click the animals with the mouse. If the animal they click is an animal on their list, a green checkmark will appear where they clicked as a visual cue to tell the player they successfully located an animal. A box next to the animal's name on the list will also become checked off when the animal is found and clicked by the player. The game ends when time runs out or when the player has found all of the animals on their list. If the player has found all of the animals in a level before time has run out, a screen is displayed which congratulates the player for locating all of the items on their list and allows them to travel back to the level selection screen.

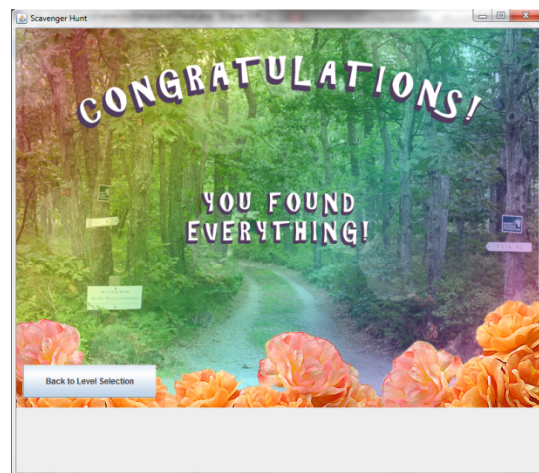


Fig 2: The victory screen seen when a player has found all animals in the first level of Scavenger Hunt.

The game was designed in this way in order to try and communicate the feeling of going on an excursion outdoors. Research has been done which suggests that being outdoors can

reduce a person's stress (Annerstedt, 2010). The intent was to capitalize on this calming aspect of nature by making the game focus the player on such images. By allowing time to pass at a relatively slow pace, the player has time to examine the picture thoroughly without feeling pressured. There is an option to pause the game if the player is feeling frustrated or pressured, allowing them to easily take a break and come back later. Scavenger Hunt also eases players into the game by allowing all of the animals on the list in the first level to be found the entire duration of the level. This allows the player to familiarize themselves with the layout of the game, while leaving them with ample time to find all of the animals on their list.

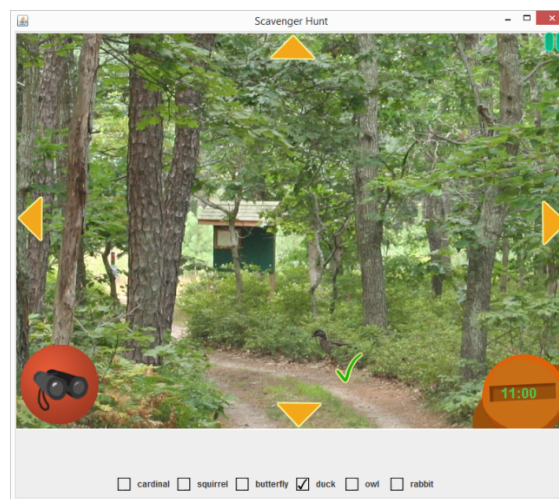


Fig 3: The first level of Scavenger Hunt, zoomed in. The player locates and clicks on a hidden animal, seeing a checkmark where they clicked. The item on the list is also checked off.

There are no sound effects or music in the game. Instead, all progress is indicated with visual cues. This is intentional, as studies have already been done connecting the background music of a video game to decreasing stress in the player (Hébert, 2005). My intention was to test

how successful the game play would be at reducing stress, and adding music would have tampered with those results.

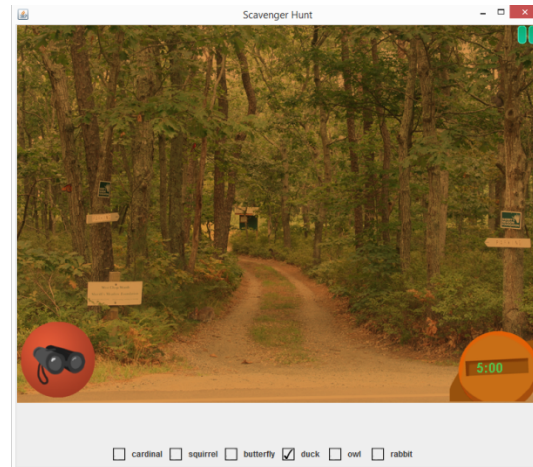


Fig 4: The first level of Scavenger Hunt at sunset.

Methodology

Participants

Participants in this experiment were gathered from classmates and friends in the Computer Science department. All participants were either Computer Science majors or had taken multiple Computer Science classes at the university. Six (6) participants were gathered to take part in the experiment and each participant did one, randomly selected activity. The ages of the participants fell in the range of twenty (20) to forty-four (44) years old. The five of the six participants were between twenty (20) and thirty (30) years old. The five of the six participants were male.

Instruments

An Omron BP-629 Automatic Wrist 3 Series Blood Pressure Monitor was used to take the blood pressure of participants before and after their activities. The two activities involving computer games were played on a 14.5" HP Pavilion laptop running Windows 7. The same laptop was used to develop the game Scavenger Hunt, which was created using Java in the Eclipse IDE. Due to Scavenger Hunt's use of the mouse as the main source of input, a simple mouse with a cord was attached to the laptop when Scavenger Hunt was played. Tetris Marathon was played on the internet on a Mozilla Firefox browser and used the keyboard built into the laptop.

Procedure

A participant would enter a barely used Computer Science faculty office which contained some chairs, a desk with a computer, and some file cabinets. The door was shut to avoid outside distractions and the participant was given a survey. The survey asked for information such as participant age and perceived stress level. If a participant was under the age of eighteen (18),

they would not be allowed to participate. After the participant filled out the survey, their blood pressure was taken using a small, digital blood pressure cuff. The blood pressure reading and pulse were recorded by the experimenter. The participants were then read an introduction to their activity. Activities were done for ten (10) minutes, with the experimenter keeping track of the time and telling the participants when the time was over. For participants whose activity was the relaxing breathing exercise, the test giver spoke quietly when announcing that time was over to avoid startling the participants. After the allotted time has passed, the participants were given a concluding survey and their blood pressure was recorded a second time by the test giver. The participants were then given a t-shirt as a gift for their participation.

The first group played Scavenger Hunt, the game created for the experiment. In this game, the participants are shown a list of animals that can be found within a series of pictures. The participants use the mouse to navigate through the pictures and click on the animals. There are two varieties of images in each level of the game. One is an image of the entire level. By clicking on a pair of binoculars in the bottom left corner, the player can change this full sized image to a series of zoomed in images. These images are sections of the full image that have been increased in size. They can be navigated between by clicking arrows along the edges of the game window. When an animal is located in the zoomed-in image, a green checkmark will appear where the player clicked and the animal will be checked off of the list. There are five (5) levels of the game, each lasting approximately 4 minutes if the player does not locate all of the hidden animals. A level will end when all animals on the player's list are found or when time runs out. The passage of time is shown by a digital watch in the bottom right of the screen. As "hours" of in-game time go by, the lighting in the images will change from daylight to sunset and then from sunset to night. A pause button will be available in the top right of the screen,

allowing players to pause the game if they feel they need a break. There were no sound effects or music played by the game.

The second group played Tetris Marathon on the website Tetris Friends. This traditional Tetris game is played by using the computer keyboard. The arrow keys are used to move and rotate falling, differently shaped blocks. The player can save a falling piece for later by pressing the "shift" key. The player is able to pause the game at any time by pressing the "p" key or the "esc" key. When paused, the game shows the player these controls. The objective of the game is to create horizontal lines that extend across the board. These lines are created by the falling shapes. When a line is completed, it is removed from the board and all blocks above it are moved down one row. The player earns points for each line created. As the player creates more lines and their score increases, their "level" increases, which causes the shapes to fall at a faster speed. The game is over if the falling shapes become stacked up past the top of the playing field. There were no sound effects or music played by the game.

The third group partook in a relaxing breathing exercise. They were read instructions by the test giver explaining the exercise. Participants were told to sit up straight and count their breaths as inhales and exhales. For example, they will count one (1) after their first inhale and then two (2) after they exhale. They will continue this until they reach a count of ten (10). Then, the participant will restart their count from one (1). The participant continued this in silence for the duration of their activity. Participants could decide whether they wanted to close their eyes or not during this activity. No music was played in the background while this activity was being done by participants.

Results

Participant Demographic Information

Participant Number	Activity Number	Gender	Age
1	1	Male	20
2	1	Male	29
3	2	Male	20
4	2	Male	23
5	3	Female	44
6	3	Male	24

Activity 1 (Scavenger Hunt Game) Blood Pressure

Participant #	Blood Pressure Before Activity	Pulse Before Activity	Blood Pressure After Activity	Pulse After Activity
1	140/80	73	132/93	71
2	118/82	73	110/80	70

Activity 2 (Tetris Game) Blood Pressure

Participant #	Blood Pressure Before Activity	Pulse Before Activity	Blood Pressure After Activity	Pulse After Activity
3	141/92	105	130/75	97
4	149/91	56	139/84	54

Activity 3 (Breathing Exercise) Blood Pressure

Participant #	Blood Pressure Before Activity	Pulse Before Activity	Blood Pressure After Activity	Pulse After Activity
5	123/74	66	112/75	57
6	112/79	72	117/75	63

Discussion of Results

The results of all three activities appear to show a decrease in pulse for every participant after their activities. The blood pressure of the participants who played Scavenger Hunt and Tetris Marathon also seemed to decrease after their activity. The only participant whose blood pressure did not decrease was the male participant in the breathing exercise activity. This reaction lines up with previous research about young men getting antsy when left to do nothing for a period of time (Wilson, 2014). On their surveys that were filled out after the activity, all subjects except for one reported that they felt their activity affected their stress level in some way. Both participants who played Tetris Marathon said that they believed their activity had helped reduce their stress. The participants who did the breathing exercise differed in their opinion as to whether the activity had reduced stress. The participants who played Scavenger Hunt were also split on whether their activity had reduced stress.

Effectiveness of Scavenger Hunt

Both participants who played Scavenger Hunt reported being agitated by the fact that they had to wait for time to pass in-game to find all of the animals on the list. They both said that they would have preferred to have an option to skip ahead in time in the game in order to search for the animals that only appeared at night sooner. Both participants had a history with

video games and their skill level most likely had a significant impact on how they played the game. They also both expressed an interest in finding all of the animals on the list as quickly as possible, even though this was never given as an objective. The two participants reported that they found the game to be either relaxing or fun, in spite of waiting for time to pass being agitating or stressful.

Taking the thoughts of the participants into consideration, as well as looking at the results from the participants who played Tetris Marathon, it seems that a condition for a game to relieve stress is how absorbing the game is. Tetris is an increasingly fast paced game that requires the player to think on their feet and concentrate on the game in order to win. Scavenger Hunt's focus on waiting for time to pass was not effective in this regard because the waiting took the player's concentration away from the game and let their mind wander. It is also a possibility that the impatience shown by players of Scavenger Hunt can be tied into the research showing that young men are more antsy and impatient, which would lead this style of game-play to agitate them rather than calm them. In order to truly prove how effective Scavenger Hunt was in reducing stress, a female audience would also have to play it. However, since a goal of this study was to create a game that would reduce stress in a broad audience, this study has shown that the concept of waiting will agitate young male players and therefore should not be incorporated into Scavenger Hunt in order to reach that broad audience.

Future Possibilities

From these very preliminary results, it seems that the best way to make a game that is relaxing to a broad audience would be to make it more involved and absorbing. The male demographic did not respond well to activities where they had to sit quietly with their thoughts, but seemed to be positively affected by the game play of Tetris Marathon. Both participants who played Scavenger Hunt said they would have enjoyed it more and been more relaxed by it if they were able to skip forward to the different daylight conditions where animals would appear. If the development of Scavenger Hunt were to be continued, the feature to advance time in the game would need to be added. This would result in the levels going by faster, so more levels would need to be developed in order for the game to last a playable length of time. Perhaps the levels could become randomly generated, creating lists and hiding animals on the same handful of backgrounds so that the player could keep playing as long as they wanted. This might pose a challenge because the animals would have to appear in logical places, but would add to the variety and entertainment value of the game. As the game became more entertaining, players would likely be more absorbed by it in a way similar to how Tetris Marathon appeared to affect the participants who played it. The updated game would then have to be tested on a broader pool of participants, consisting of more balanced genders, different backgrounds and different ages.

References

- Annerstedt, M., et al. (2010). Finding Stress Relief in the Forest. *Ecological Bulletins*, 53, 33-42.
Retrieved March 29, 2015
- Bernier, F. (2011). Enhancing stress management skills in military personnel using biofeedback and immersion in a stressful videogame: A randomized control trial. *Journal of CyberTherapy and Rehabilitation*, 4.2, 209. Retrieved February 28, 2015, from Academic OneFile.
- Casual Games Association - Research and News. (n.d.). Retrieved February 28, 2015, from <http://www.casualgamesassociation.org/news.php#casualgames3>
- The dopamine side(s) of depression | The Scicurious Brain, Scientific American Blog Network. (n.d.). Retrieved March 9, 2015, from <http://blogs.scientificamerican.com/scicurious-brain/2012/12/17/the-dopamine-sides-of-depression/>
- Hébert, S., Béland, R., Dionne-Fournelle, O., Crête, M., & Lupien, S. (2005, April 1). Physiological stress response to video-game playing: The contribution of built-in music. *Life Sciences*, 2371-2380.
- Holmes, E., James, E., Coode-Bate, T., Deepröse, C., & Bell, V. (2009, January 7). Can Playing the Computer Game “Tetris” Reduce the Build-Up of Flashbacks for Trauma? A Proposal from Cognitive Science. *PLoS ONE*, E4153-E4153.
- Koepp, M. (1998). Evidence for striatal dopamine release during a video game. *Nature*, 393(6682), 266-268.

National Institute of Mental Health. Fact Sheet on Stress. (n.d.). Retrieved February 28, 2015, from <http://www.nimh.nih.gov/health/publications/stress/index.shtml>

O'Brien, K., Parks, J., & Russoniello, C. (2009). The effectiveness of casual video games in improving mood and decreasing stress. *Journal of CyberTherapy and Rehabilitation, 2.1*, 53. Retrieved February 28, 2015, from Academic OneFile.

Pew Research Center. Mobile Technology Fact Sheet. (2014, November). Retrieved April 5, 2015, from <http://www.pewinternet.org/fact-sheets/mobile-technology-fact-sheet/>

Wilson, T. (2014). Just think: The challenges of the disengaged mind. *Science, 345*(6192), 75-77. Retrieved April 28, 2015, from <http://www.sciencemag.org/content/345/6192/75>

Woollaston, V. (2013, May 14). Candy Crush Saga soars above Angry Birds to become WORLD'S most popular game. Retrieved February 28, 2015, from <http://www.dailymail.co.uk/sciencetech/article-2324228/Candy-Crush-Saga-overtakes-Angry-Birds-WORLDS-popular-game.html>