
Faculty of Science and Technology

BSc (Hons) Games Programming

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# An examination of how artificial pets affect a player's emotion and influence behaviour within a game

By

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# Abstract

Companions have become a common component within triple-A title games. By having a non-playable character (NPC) follow a player around, it allows a game to offer handicaps to the player and assist them throughout their journey. Another aspect that companions bring to a game is loyalty and narrative which can entice the player into feeling a bond between themselves and the entity. In this paper, the topic of this bond generation will be examined. Additionally, the reasoning for its occurrence will be researched and closer investigated. This will consider what aspects are needed within a game to trigger the building of this type of emotion. Furthermore, the effects of bond generation will be examined, more closely the impact the virtual relationship could have on the game-play-style. In addition to this, a simulation will be developed for the purpose of investigating if using emotional state models, such as the PAD model, can be used to create the mentioned bonds between the player and the virtual entity. This also serves to examine if the players would adjust their behavior as time progresses. Finally, results will be evaluated to conclude whether and to what extend the above has occurred.

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# Chapter 1 - Introduction

The games industry is continuously expanding, with thousands of companies publishing games that differ in various aspects. Alongside games, AI (Artificial Intelligence) is also growing at an unprecedented rate. These two cooperate to allow certain games to create entities within their world that bring both, emersion and emotion. These entities, known as NPC's, can change their actions to suit the environment, allowing different reactions to situations. NPC companions are used in games to add more depth to the game play and narrative as they will interact with the world and assist the player. As Trembley and Verbrugge said, "Companions are an essential part of the player experience, ensuring the player has fun and a sense of immersion in the game world" (2013, p2).

Games have used NPC's to drive them forward for decades, and with them growing in size and content, an increased amount of AI driven content is required to simulate dynamic game play. Dynamic game play describes a state in which the game implements scenarios that may divert the player from the main storyline. They push the player to new content that may affect the game's narrative. An example of this might be introducing the back story of NPC companions in a "side quest" and giving the player a choice whether to pursuit it or not. In Mass Effect 2, this is clearly shown with each follower that the main character gathers. They each have a set of side missions and if they are not completed, the NPC followers have a chance of dying and not returning in future games.

This technique is widely used and has a unique effect, resulting in the player becoming emotionally attached to the NPC's. Thus, they might start to change their in-game choices to better suit their companions with an intention of the outcome better suiting the followers and changing how they view and interact with the player.

This kind of AI integration has been heavily researched aiming to improve the overall game play but the effect of emotional bonding between the player and NPC's is still limited in research. Chowanda (2016, p2) states: "Research has been done to enhance the player experience by improving their believability. However, only limited

research has been done to incorporate emotion, personality and social relationships models together". Researching into the effects of emotional bonding between both player and AI is becoming increasingly crucial to the industry though, as the effect of the relationship can change the users experience and overall game play decisions.

## Aims and Objectives

The overall aims of the project are:

i. The primary aim is to show how players can grow and nurture an emotional bond between them and an AI companion within a game.
ii. The secondary aim is to create a game that tests the bond between an NPC pet and the player. The game will aim to generate a relationship that the player needs to maintain in order to keep the pet alive and happy.

To successfully achieve these aims, the objectives will need to be completed:

1) Primary Objectives:
   a) To gather statistical data on how players grow an emotional bond and whether it effects their game play experience or not.
   b) To create a virtual pet simulation game in which the player must care for a common house pet in real time. Primary features will include:
      i) Basic saving and loading of the game
      ii) A semi-realistic environment which will house the pet
      iii) An animated 3D model of the pet
      iv) Basic actions such as feeding, watering and cleaning
      v) Basic interaction and reaction to the house pet
      vi) Dilemmas within the game to create a challenge
      vii) Use for Android platforms
      viii) Clear UI of information about the pet
2) Secondary Objectives:
   a) Improvement of the simulation:
      i) Improved reaction and movement from the house pet

ii) Consequences for the player's mishandling
iii) Improvements to overall layout of the game's features
iv) Optimization of the game for more platforms
v) Added effects that show the current state of the pet (including information displayed on the UI)

# Chapter 2 - Literature Review and Background Theory

The simulation of AI emotions is believed to be complex and very time consuming, especially when aimed to represent behavior somewhere close to realism. To create variables that adjust the emotional state takes tactical planning to ensure a dynamic system. Although the effect the emotional state system has is exponential, if used right. Greer (2013) states that the varying levels of response from the emotional state revolve around the player's personal experience and the developer's intent. This means that there is a direct connection between how much the developer implements, in the form of AI, to the amount the player will be invested emotionally. Freeman (2004) states:

> *"When a game has emotional complexity, combined with fun game-play, the creative team becomes inspired; they know they're creating something that has depth, meaning, and impact, and not just superficial entertainment."*

Further, Freeman (2004) continues to talk about how emotion in games is not just meant for profit or publicity, although these are factors. He explains that when a game becomes a part of someone's life and enjoyment, it becomes an experience to them as well. They then develop emotional attachment to that experience and will ponder on it throughout the further course of their life.

By implementing aspects of emotional attachment into games, a game's characteristics can change and turn into a user experience. This is since the users tend to be impacted by what they have just played in general which then is supported by the emotions that they personally brought to that experience. A game also having characteristics to be classed as a user experience has the advantages of creating a strong emotional investment which often results in both, the user returning to the medium as well as them spending more time with those interactions.

## Artificial Intelligence in Games

The AI within modern day games push the boundaries of how NPC's interact with the player. By creating entities as a possible progression mechanisms, the game can become less linear and more personal to the player. It starts to allow them to progress in whichever way they desire and for as long as they desire to, usually

reaping more rewards. This creates a world of possibilities that can form the illusion of the environment being more immersive and realistic with the player not being the only “living entity” in a normally static world. Additional to general NPC’s being used to widen the horizon of the in-game environment, NPC companions have a history of providing support and help throughout the game progress. As Greer (2013, p.1) describes:

> *"An exceptionally pleasurable narrative is one in which a player experiences themselves not as a solitary figure alone in the game space but one who shares the journey with a wise, supportive companion." (Greer, 2013, p.1)*

The connections built can enhance experience not only by pushing the narrative forward but also by simply providing company and creating the feeling of companionship.

Trembley and Verbrugge (2013) state:

> *“The companion’s goal is to help the player accomplish in-game goals, simulating the effect of actual co-operative game play.” The companions are designed to run the player through the game, helping the player through battles and expand the narrative. NPCs are growing in realism due to their capability of effecting the game world and what inhabits it.“*

Research has been undertaken to enhance the player’s experience by improving their NPC’s believability. However, the research into “incorporating emotion, personality and social relationship models together” is still scarce (Chowanda et al, 2014). The realism of companions comes from their ability to adapt to the players in-game decisions. Although this does not always go as far as incorporating diverse personalities which people would usually display. A companion who agrees with a majority of what the player does though, opposed to one staying true to personal believes or aspirations, shows that they are not entirely human in nature which declines their realism to an extent.

In a lot of cases, companions imply to be entirely willing to support the player at all times, following their moves, assist them to a large number of their decisions and reply with compliance. This display of loyalty is not just shown by humanoid followers, but also by animal companions that the game implements. Animal companions have been used as a mechanism for virtual bonding for many years and allow a unique relationship to develop compared to one that exists between the player and a human NPC. Virtual animals are easier to create as a companion that

show emotion and personality due to their more simplistic values. They require simple tasks to please and show no resistance when making bad decisions, which allows the game world to adapt to the players mistakes without any hesitance. This results in the ideal companion who does not forcibly change the game play style of the player, but instead, supports it through emotional bonds.

> *"Through a series of interactions with the virtual pet (e.g. feeding, washing, playing ball, etc.), students establish a deeper relationship with it" (Chen et al, 2011).*

Chen explains and supports the previously made assumption that virtual animals do not require in-depth interactions for the users to build a relationship, and that simpler tasks such as playing with the animal could be enough for a bond to be built.
Another benefit of choosing animal characters as companions can be that less aspects need to be designed, such as a back-story or following personal goals.

## PAD Emotional State System

To enhance a companion's believability and to prevent an always compliant follower as described above, an emotional state system needs to be integrated into the NPC itself. A system that allows the NPC to change its emotional state depending on the actions of the player. This allows the NPC to become more dynamic in how it approaches situations relevant to the player, such as the main character having to choose between two possible options, one of which the NPC might disagree with. If a choice like this is made, the follower can start to show negativity towards the player.

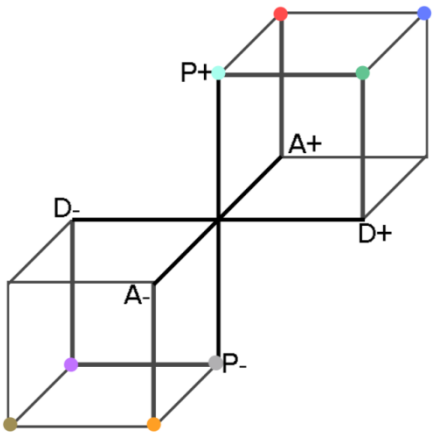


**Figure 1 - Three Dimensional PAD Emotional State Model**

One of the approaches to this type of system is the PAD emotional state model. The PAD emotional state model was developed by Albert Mehrabian and James A Russell and is used to track emotions within psychology studies. Zhang describes the PAD system:

> *"Human emotion is not limited to isolated categories but can be described along three nearly orthogonal dimensions: pleasure-displeasure (P), arousal-nonarousal (A) and dominance-submissiveness (D)." (2007)*

The use of three dimensions allows the PAD emotional state model to update

emotions in a dynamic way, allowing the overall system to create and monitor emotions within a project. Figure 1 shows how the PAD model can be interpreted. The figure shows a three-dimensional space where each PAD value is depicted as an axis. In this example of the PAD emotional state model, the pleasure-displeasure (P) value can be interpreted as the dominant factor. The alignment of the P value dictates the type of emotional state shown, if the value is P+, then the emotional state will be positive, if the value is P-, then the emotional state will be negative. Knowing that the PAD emotional state model uses three dimensions to categorize the emotions of an entity, the effects of changing the model to two dimensions is described by Mehrabian himself. He states:

> *"Although use of only two of these factors has been tempting because of greater simplicity, adequate characterization of important distinctions among certain clusters of affect (e.g., fear, sadness, anger) has necessitated a three-dimensional representation." (1996)*

Mehrabian explains that when factors within the PAD emotional state model are reduced for simplicity and ease of use, information and the ability to generate and track realistic emotions can be lost, due to the model only being two dimensional. For the PAD model to be used in a research project, it needs to be able to show the full dynamic range of emotions in order to give realistic results, as a two-dimensional model, it would only display happy or sad emotions. This would clearly limit its usability as emotions are described to have more depth.

## PAD Emotional State Model within Simulations

Becker-Asano and Wachsmith (2009) designed a system using a PAD model called WASABI. WASABI was a system which generated an emotional state and then used the PAD model to determine the mood of that emotional state. This system allowed each emotion to be expanded upon, which could then be used to simulate human emotions within virtual entities.

The emotional state models have been used to research the realism in virtual AI to see if it replicates human emotions. Due to this research, AI can be developed to show human-like properties and display emotions in certain technological advancements.

Figure 2 shows the diagram designed by Becker-Asano and Wachsmith describing how the top-level plane shows the primary emotional states, such as happy and sad. Those emotions are then sent to the bottom level plane where it uses the PAD emotional state model to define what sub-categorized emotion should be chosen. By using this type of model, multiple primary emotions as well as secondary emotions can be used to measure a vast number of emotional states.

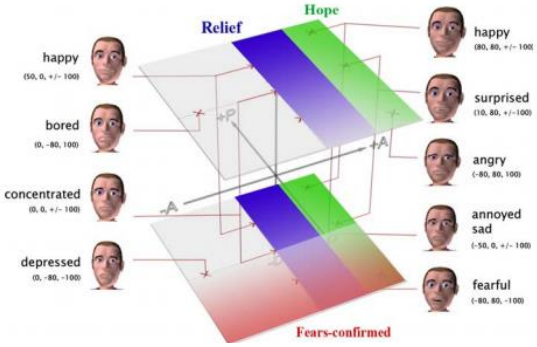


**Figure 2 - Becker-Asano and Wachsmith (2009). A diagram showing the WASABI system and how it interacts with the PAD Emotional State model.**

In addition to virtual simulations, the PAD model has also been used with audio capabilities. Jia (2011) writes about how audio can be used alongside the PAD emotional state model to allow emotional speech patterns to emerge, such as text to speech systems and facial expression to audio systems. By using the PAD model to measure emotions, these types of audio systems can be designed to express the user's emotions in a unique way of communication.

# Chapter 3 - Design and Development

To test the use of emotional bonds within a game, a simulation was designed to allow the user to experience looking after a pet hamster. The player input is designed to interact with the hamster in its daily life, simulating its basic needs. Certain actions deem if the hamster should become happier or sadder. The overall aim of the user experience is to generate a bond between the AI pet and the player. With this, the game should end with two results, the virtual pet being in a positive emotional state and the player feeling happier and content with their experience.

## Planning

To plan for the overall project, a gantt chart was designed with each objective laid out. By tracking what was finished, when it was finished and what was left to do, the estimated duration of each task can be monitored to make sure that the simulation was finished on time.

| | | Week Numbers | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| | Objectives: | 10th Oct | 17th Oct | 24th Oct | 31st Oct | 7th Nov | 14th Nov | 21st Nov | 28th Nov | 5th Dec | 12th Dec | 19th Dec | 26th Dec | 2nd Jan | 9th Jan | 16th Jan | 23rd Jan | 30th Jan | 6th Feb | 13th Feb | 20th Feb | 27th Feb | 6th Mar | 13th Mar | 20th Mar | 27th Mar | 3rd Apr | 10th Apr | 17th Apr | 24th Apr | 1st May | 8th May |
| 1 | Weekly Supervisor Meetings | C | C | C | M | C | C | C | C | C | | | | C | C | C | C | C | C | C | C | C | C | C | C | C | C | M | C | C | C | D |
| 2 | Proposal | C | C | C | C | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Literature Review | | | | | C | C | C | C | C | C | | | | C | C | C | C | C | C | C | | | | | | | | | | | |
| 4 | Project Planning | | | C | C | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Game Planning | | | C | C | C | C | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | **Implement Game Features:** | | | | | | | D | D | D | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | E | E | | | | | |
| 7 | PAD Research | | | | | | | C | C | C | | | | | | | | | | | | | | | | | | | | | | |
| 8 | PAD Implementation | | | | | | | | | | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | E | E | | | | | |
| 7 | Implement House Pet Basic Features | | | | | | | D | D | D | C | | | | | | | | | | | | | | | | | | | | | |
| 8 | House pet Commands | | | | | | | D | D | D | C | | | | | | | | | | | | | | | | | | | | | |
| 9 | Model and Texture House Pet | | | | | | | | | | D | | | | | | | | | | | | | | | | | | | | | |
| 10 | Animate House Pet | | | | | | | | | | | D | D | D | C | C | C | C | C | C | C | C | C | C | C | E | E | | | | | |
| 11 | Model and Texture Environment | | | | | | | | | | C | D | | | | | | | | | | | | | | | | | | | | |
| 12 | Implement Menus | | | | | | | | | | | | D | | | | | | | | | | | | | | | | | | | |
| 13 | Implement Naming | | | | | | | | | | | | D | | | | | | | | | | | | | | | | | | | |
| 14 | Implement Saving and Loading | | | | | | | | | | | | C | C | | | | | | | | | | | | | | | | | | |
| 15 | Add Interaction with House Pet | | | | | | | | | | | | | | C | C | D | | | | | | | | | | | | | | | |
| 16 | Add Reaction from House Pet | | | | | | | | | | | | | | C | C | D | | | | | | | | | | | | | | | |
| 17 | Implement Dilemmas | | | | | | | | | | | | | | | | | D | D | | | | | | | | | | | | | |
| 18 | Implement UI for the game | | | | | | | | | | | | | | | | | | | C | | | | | | | | | | | | |
| 19 | Build for Android Platform | | | | | | | | | | | | | | | | | | | C | | | | | | | | | | | | |
| 20 | In-Depth Testing | | | | | | | | | | | | | | | | | | | | D | | | | | | | | | | | |
| 21 | Contingency | | | | | | | | | | | | | | | | | | | | | C | C | C | C | C | C | | | | | |
| 22 | Testing | | | | | | | | | | | | | | | | | | | | D | D | D | D | D | D | D | C | | | | |
| 23 | Dissertation | | | | | | | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C | C |
| 24 | Polish Game for hand in | | | | | | | | | | | | | | | | | | | | | | | | | | | | M | M | M | C |
| 25 | Finalise and Print | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | C | C |

U - Uncompleted
C - Completed
M - Missed
D - Delayed
E - Extended

**Figure 3 - Project gantt chart**

Figure 3 shows the project plan from start to finish. Certain delays were implemented due to the discovery of the PAD emotional state model and how it can be used within games. The PAD model was the emotional state system needed for the simulation which required the development of the simulation to be delayed so that the PAD model could be undergo in-depth research into how it can be fully integrated. Due to the delay of the implementation, certain features required delaying and extending to

allow other implementations to be finished and fully operational. All of the objectives are listed in order of priority, meaning if an implementation was not finished or implemented properly, development of the other features would have to be delayed.

## User Experience

To create a simulation where a bond can be created, the user experience should be aligned with the goal. The system has to provide opportunities for the player to take certain actions to change the emotional system of the virtual pet.
This virtual pet is used to simulate the real-world responsibilities of owning an animal. For this, the hamster was chosen, as the research conducted by André et al (2009) showed that they were highly popular due to their use in movies and games. Additionally, hamsters have been used as a motivational mechanism in educational settings.

## PAD Implementation

The experience will rely on two aspects, the player interacting with the virtual pet to take care of it, and the hamster reacting to the interactions of the player. The virtual pet should make an impact on the player with two properties, its cuteness and the need for attention. This will prompt the user to interact with the hamster with the result being a reaction from the hamster.

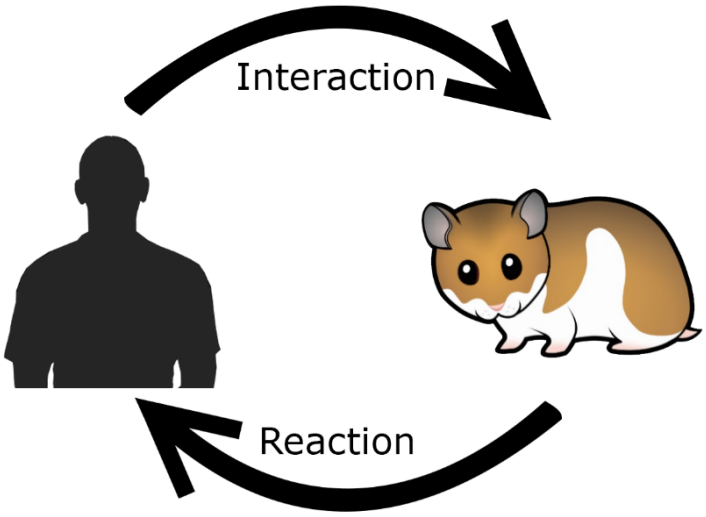


Figure 4 - Interaction and Reaction Diagram

To implement the PAD emotional system, certain parameters are required. With the PAD system containing three parameters, one for the pleasure, arousal and dominance, a system needs to be implemented that adjusts these values. These values then calculate the current emotional state that the entity should be in and, in result, will change the way the AI works and reacts.

Within the simulation, the PAD system comprises of 3 factors, the player's interaction, the emotional state updating and then the reaction from the entity. These all link together creating a feedback loop where the information from each section is passed to the next segment, altering the outcome.

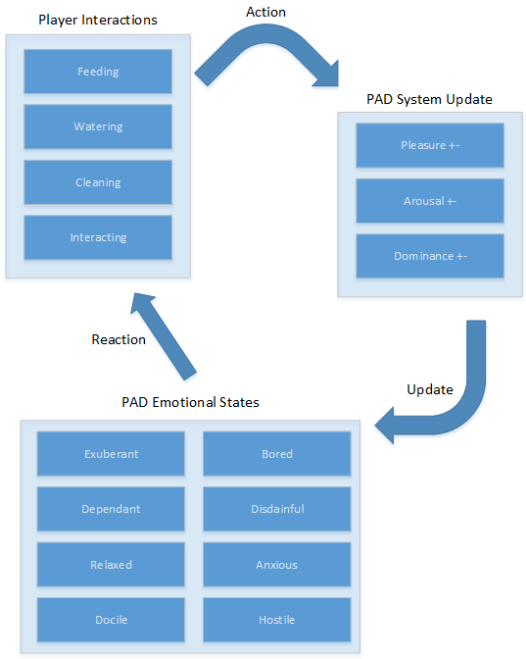


**Figure 5 - PAD system update loop containing player interactions, PAD system update and PAD Emotional State reaction**

## Player Interactions

The interactions within the PAD system are designed for the purpose of the simulation. Each interaction is used to complete a task within the system in order to accomplish a goal. In relation to the simulation, each interaction is used to take care of the hamster and its general needs. There are 4 actions available to the user to interact with the hamster: feeding, watering, cleaning and interacting in general. Each of these actions cycles information to the PAD state system.

In addition to the player actions, a timed system exists within the game that checks the amount of time the player has been away for. This system is to replicate the passing of time outside of the game. By tracking the amount of time the system is active, the program can calculate the downtime and how much the PAD emotional states would have updated. While the system is inactive, certain actions are called automatically. This is when the entity has not been interacted with and will cause the PAD system to reduce, changing the emotional states to negative emotions.

The simulation tracks the food, water, hygiene and interactions of the virtual pet. When the properties of the entity are extremely low, this prompts the system to reduce the PAD system. This is due to the mismanagement of the hamster which will cause negative emotions to emerge towards the user. For the system to start increasing again, the player is required to start interacting with the virtual pet, in hopes of returning it to its original emotional state.

## Emotional States

The PAD emotional state system receives the information from the player's actions. For the simulation, the data is passed depending on the action used. Each action will adjust certain parameters, raising or lowering the PAD variables.

The change in the parameters determines how quick each emotional state will transfer to a new state. The PAD model of the simulation updates with values of 0.01 and 0.03 since these values allowed the system to progress at a suitable state.

| PAD | Emotional State |
|---|---|
| P+ A+ D+ | Exuberant (Excitement) |
| P+ A+ D- | Dependant |
| P+ A- D+ | Relaxed |
| P+ A- D- | Docile (Submissive) |
| P- A- D- | Bored |
| P- A- D+ | Disdainful (Lack of Respect) |
| P- A+ D- | Anxious |
| P- A+ D+ | Hostile (Angry) |

Figure 6 - Table showing the 8 different emotional states in the PAD model

As visible in figure 6, each of the emotions is categorized into negative and positive emotional states. They are shown as either + or – which is how the PAD system will understand which emotional state the entity is currently displaying. The pleasure value defines the type of emotion that is shown. If the pleasure value is positive, then the virtual pet will demonstrate happier emotions and if the value is negative, then sadder emotions will be shown. The arousal and dominance values are used to define the sub-emotional state within the PAD system.

As different actions cause the pleasure, arousal and dominance values to increase or decrease differently, they are rarely the same value, which means that emotional

states are needed for each possible outcome. A larger number of emotional states allow the PAD model to generate more intense and realistic emotions for the virtual entity, allowing the NPC to react in a more realistic way.

Within the simulation, two more emotions are added to the previous eight, passive happy and passive sad. The two emotions allow the PAD system to change between the positive and negative emotions in a realistic way. The change between the anxious (P- A+ D-) and dependent (P+ A+ D-) emotional states were erratically. With the addition of the passive sad and passive happy emotion, the change is slower but allows the reactions of the entity to show a progressive change, instead of instantaneous.

Emotional State Reaction

After the system updated the PAD emotional state, the virtual entity has to react to the action of the player. With the "Tamagotchi toys" (Bandai, 1996) that were released during the 1990's, the virtual pet would display images of its happiness and produce noises to prompt the user that it was becoming happier as a direct result the user's interaction. The game "Black and White" (Lionhead Studios, 2001) showed emotional animations through the pet a player was given. This pet would not be tamed unless the player taught it too. If the pet acted badly, the player would have to punish it by hitting it or pulling on its leash. The virtual pet would then react and display its bad mood and rarely interact with the player. Eventually, it would do something good, which would earn the player's praise causing it to be in a good mood.

**Figure 7 - Bandai, 1996 - Tamagotchi Toy**

**Figure 8 - Lionhead Studios, 2001 - virtual pet from Black and White**

These two games use similar schematics to portray their emotional state. Using sound and animations, the virtual pets can show the player their current emotional state and allow the player to determine how to interact with it next. Riva et al (2007) states that the use of visual, aural, and haptic interfaces allows the user to experience the environment as if he/she was a part of the world. By implementing

animations and sound effects, the player can become more immersed in the experience and start to bond with the entities in the world.

## Audio Implementation

Västfjäall (2003) researched into the effects of positive and negative sounds on a person. His research concluded that audio can be used to increase the positive and negative emotions of people when listening to the music and sound effects. In addition, he mentioned that the use of different sound systems can also affect the mood of the user.

The use of sound within this simulation is to create an environment that can be used as a positive platform for the user. To improve their happiness when playing the game allowing the possibility of the user prolonging their interaction with the hamster, increasing the likelihood of a bond developing.

## Animation Implementation

In addition to the audio reactions mentioned in the previous paragraph, the visual reactions must accompany the overall visual aspect of the virtual pet. By creating animations that show what the entity is doing and what emotional state the virtual pet is currently in, the user can start to recognize patterns within the system and start to work out how the states connect and how to interact with the hamster to change its emotional state resulting in positive outcome.

Figure 9 - Image of the virtual hamster during the "exuberant" state

Each animation is required to show a different property of the virtual pet, such as hunger, dehydration, uncleanness and others. Animations help to bring the entity to life, meaning more animations attached to the virtual pet make the simulation feel more realistic.

Using the PAD model, the emotional states should each have an animation to react to the user's interaction. In the simulation, every one of the ten emotional states, therefore has one equivalent animation which is shown when the player interacts with the virtual pet. They clearly depict the current emotional state the pet is in and allow the user to know if the hamster is feeling

positive or negative.

## Additional Implementation

The PAD emotional state system is a AI procedure that allows the program to simulate emotion with a NPC. Although this allows the entity to display emotions and proceed to generate an emotional bond between the player and the virtual pet, additional features are needed to create the environment that the NPC is in. This requires to be immersive and somehow realistic. If the virtual pet lived in a blank world, the illusion of realism would be lost or restricted.

More features can be added to assist the bonding experience and to enable the PAD system to look and feel more realistic. The addition of these features also allows the user to retain more information about the virtual pet and its needs.

### Environment

Simulating a realistic environment enables the user to become immersed within the game world. By creating an environment that somehow represents the natural living standards of the virtual pet, the simulation starts to show realistic properties. In addition to having an environment that simulates realism, animations that interact with the environment help show that the virtual pet lives and interacts with that world rather than it being a static back plate. The simulation has the hamster eating from the food bowl, cleaning itself in the sand pit and drinking from the water bottle.

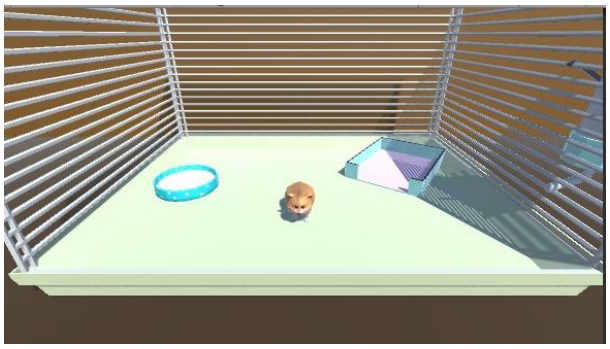

**Figure 10 - Image showing the virtual hamsters environment in the simulation**

### Textures

In addition to the environment, textures bring the scenery to life, showing colour in the game world. The textures allow a bland, unimaginative environment to emphasize and distinguish each key aspect, even to the smallest

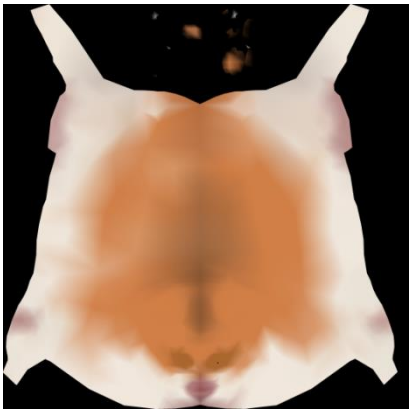

**Figure 11 - Hamster texture used within the simulation**

detail. Even without the use of complex shaders, textures help the overall realism of the game world and emphasize certain aspects of the environment, such as the hamster's utilities. The texture for the hamster shows individual body parts more clearly such as the nose and eyes, allowing the low poly model to appear higher in quality and realism while not losing its unique style and value of cuteness.

## User Interface

The user interface (UI) is a specific way of showing certain information to the user. By using a UI in a simulation, key information can be display showing the user what to do. While displaying information to the user can allow them to progress quicker, it can hinder the experience if too much vital information is displayed. This means the right amount of information is needed to assist the overall experience. Additionally, the way the information is given also needs to be taken into consideration. With simulation games in general, information is displayed mainly when the player needs it or when the information needs to be displayed, not distracting from the simulation when unnecessary.

When showing information, it needs to display data that is relevant to the virtual entity. Within this simulation, the information given to the player through the UI gives a guidance on how hungry, thirsty and unclean the hamster is. This allows the player to decide what action they need to complete for the hamster to stop being in a negative emotional state. The UI shows the information in the form of health bars. The health bars decrease over time, using the PAD time system.

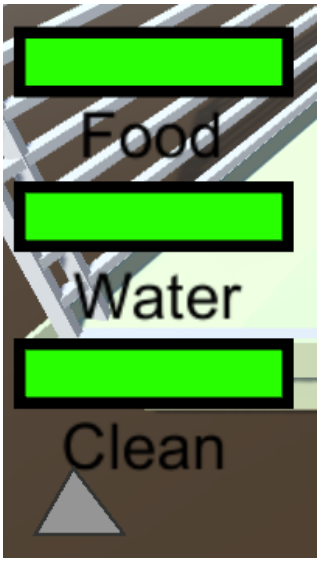


Figure 13 - UI in the simulation before the hamster requires any interaction

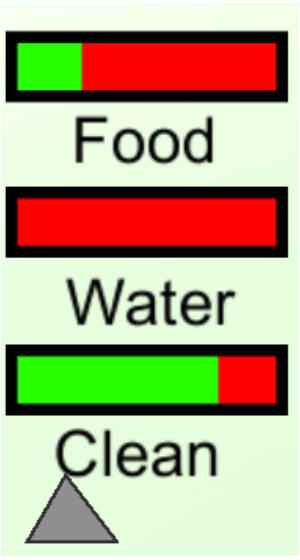


Figure 12 - UI in the simulation while the hamster requires interaction

They slowly reduce to show red bars, which indicates to the player that certain actions are needed. Diemer (2015) explains that the use of visual data in a user interface creates a more immersed experience compared to informative data. When the information is displayed in a visual and creative way, it becomes easier to read and understand. Figure 13 shows the hamster's stats when they are not requiring any attention, showing the player that no action is needed. Figure 12 however shows that the hamster is in need of water drastically, which indicates that the hamster has been neglected and will presumably be in a negative emotional state. The UI does not show this information constantly through the user experience. Instead, it appears when the user wants to see the hamster's statistics or when it is currently engaged in an action. This allows the user to see the information periodically, permitting them to start to experience realistic traits of pets. In a real-life scenario, the pet's emotional state would not be constantly provided to the owner in a clear way. Recreating this in the simulation by limiting the information, creates an additional sense of realism in the user experience which can help generate the virtual bond.

## Device Implementation

"Tamagochi" showed that simplistic devices can still be an effective tool for gaming. The portable device allowed the user to access their virtual pet wherever they wanted to and tend to its every need easily. For the simulation, the android platform

was chosen as the device for the users to interact with the virtual pet. By allowing the simulation to become portable, the user is enabled to interact with their hamster on a regular basis, checking to see how the hamster is feeling and tend to it if needed. Having the hamster with the user everywhere also allows the user to feel attached more easily, as they know that whenever they want to access the system, they can. This emphasises the idea of the pet being loyal. Each user having their own virtual pet that is unique to them, builds on their emotion and helps to construct a relationship more easily.

## Testing

To determine if the simulation was capable of generating a bond between a user and a virtual pet, testing had to be conducted. The tests involved five subjects first answering a set of questions about their personal views on the simulation, the project, and what their predicted outcome would have been. After the questionnaire was finished, a 3-day testing period commenced. In the three days, the testers could take care of their virtual pet. They got to interact with the hamster and generated a relationship with the entity possibly aiming for it to become happier. Once the three days of testing were finished, a final questionnaire was given to the participants. The questions involved their personal experience over the three days and how successful the simulation was in generating a personal bond.

When testing the simulation, data was collected whenever the testers interacted with the hamster. This allowed a detailed line graph to show the emotional state the hamster was feeling at all times, what actions the user did to try and amend that state and how long they played for.  By saving the data, the playing habits of the tester could be examined even further to show how they dealt with the entity being in a negative emotional state and their personal play style.

All questions were formed with quantitative answers. This allowed the data to be easily compiled into a readable format that can be reviewed for answers to certain results. This format is due to the research conducted by Sandelowski (2000) who wrote about the use of quantitative research methods providing detailed information and permits statistical inferences to be made. The results can then be researched into the affect the simulation had on the testers and to see if the project's outcome was successful or not. Additionally, the same can be done with the reasoning

supporting the results, concluding if the tester's play style changed due to a possible emotional relationship created from the simulation.

# Chapter 4 - Evaluation of Results

## Initial Questions

At the start of testing, the five participants were required to answer four questions before the simulation phase began. These questions allowed the testers to give their general information and personal views on the project itself.

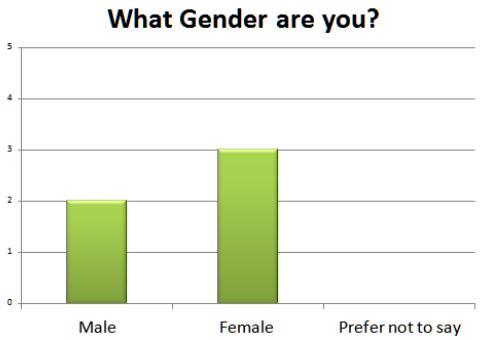


Figure 14 - Results for pre test question 1

The first question was in regards to the testers gender. By learning the amount of female and male testers that are playing through the user experience, certain questions can be pondered, such as how does the in-game decisions created by the PAD model differ between the male and female perspective. Do female players generate bonds quicker than male testers? Through the results of the testing, these questions can be answered and resolved. Figure 14 shows the difference in gender between the five testers, showing that there were three female and two male participants.

The second question enquires about the testers previous experience with simulation games. The knowledge of the testers previous engagement with simulation games can predict how the user will interact with the system. If the tester is new to simulations, they might take more time to understand how the system works. On figure 15, it can be seen the number of testers who have not played simulation games before is below half, allowing their progress to be tracked to investigating if there their progress was slow during the start of the testing.


Figure 15 - Results for pre test question 2

Knowing the testers previous gaming experience in addition to their history of bonding with virtual entities can create a prediction of their experience with the virtual hamster and how they will approach the simulation. Figure 16 shows that two of the testers have no knowledge of their relationships with virtual entities. With this information, a prediction can be made that a relationship between the participant and the hamster may struggle to form.

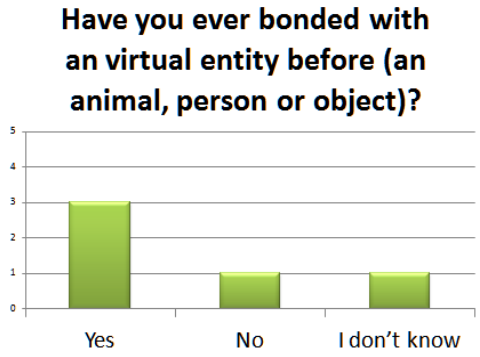


Figure 16 - Results for pre test question 3

Although this may change depending on the testers personal tastes and determination to generate a bond, the predicted outcome of the end results is likely to be that half of the testers might not build a relationship with the virtual hamster, nor did the simulation change their play styles to match the entities needs.

The final question answered by the testers was "Do you think the project will be successful in building a bond between you and the hamster?". The results, shown by figure 17, conclude that a majority of the testers did not know if the simulation would result in a success, by building a relationship between them and the hamster. Each of the testers replied with a statement to explain their reasoning behind their answer. Tester two, for example, stated: " I feel like I might get bored of it after a couple of days and forget about feeding the Hamster".

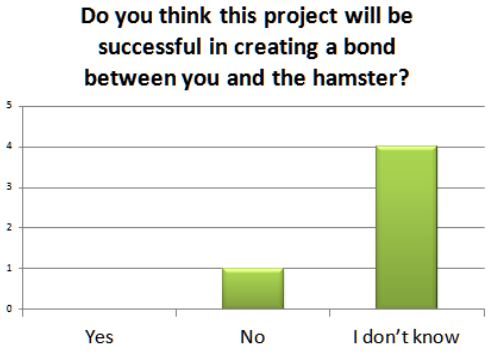


Figure 17 - Results for pre test question 4

Simulation games must appeal to the personal preferences of the player, otherwise they might not entertain the player enough to return to the game. Since each of the testers answered this way, it is shown that they were concerned not being satisfied by the user experience and the lack therefore might not motivate them to continue the game. This is one of the possible outcomes of the simulation test phase that would result in a failure to create a virtual bond between the player and the hamster. The pre-simulation test questions allow the opportunity to generate theories on the overall outcome of the testing and ask questions about how certain testers may approach the simulation differently than others. By using participants that are all different in gender and previous experience, a wider range of results can be

gathered. The information gathered can be interpreted for a wider range audience and predict what similar results could be gained with more testing.

## Simulation Testing

Once the participants had completed the initial questionnaire, the simulation testing began. The results of the simulation testing were gathered from the mobile devices the participants used to interact with the hamster. The system recorded data of the testers for every action within the simulation such as the current PAD values, the emotional state the hamster was feeling and the action that caused that data to be recorded. As the data cannot be recorded while the system is offline, the system uses a calculation to determine how much the PAD states should have updated over the inactive time. Each line graph shows the activity of one tester in a single day. The starting time variable was recorded when the player first started up the simulation for that day and continued until they stopped playing.

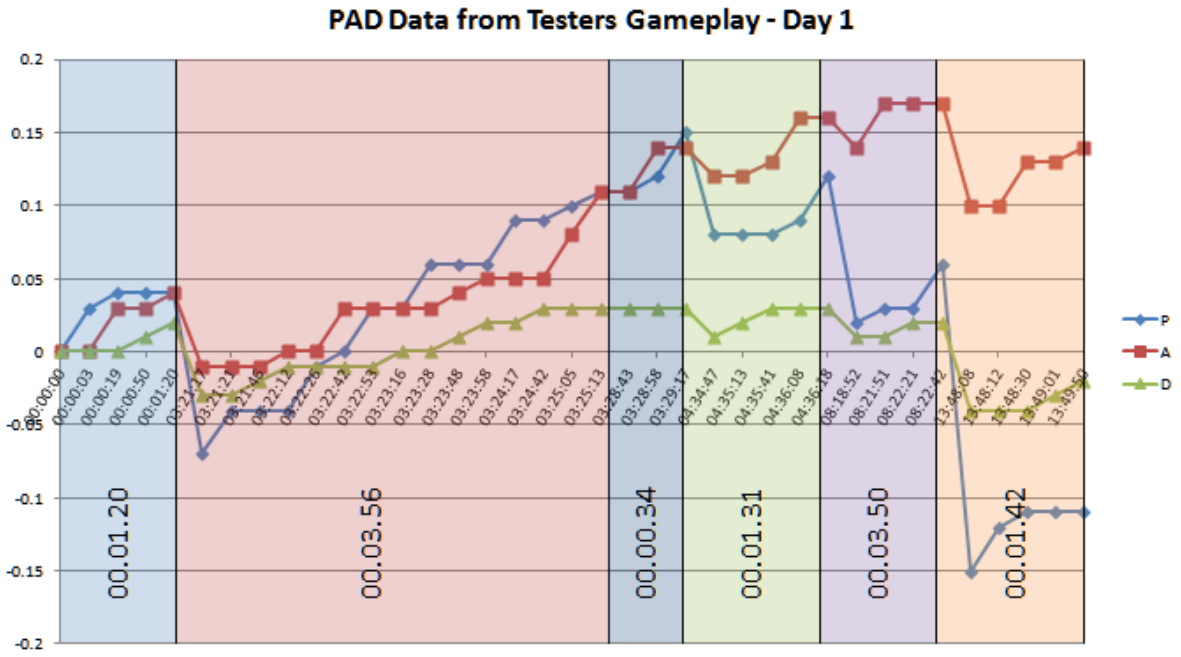


Figure 18 - Line graph showing tester two's progress through day one of testing

Figure 18 shows tester two's progress through day one of the simulation testing phase. The value at the far-left center (00:00:00) shows the starting time for the day of testing and continues to till the final time of 13:49:50, the far-right value. The values are measurements of time and show the hours, minutes and seconds of play time.

The information displayed details the amount of time the tester played for during day one. Each colored box shows the amount of played time between breaks from the simulation. Although the timings are short, the amount of interactions between each break pushes the PAD system towards the positive states. As you can see from the red box, the second section, the player interacting with the hamster for over 3 minutes push all three PAD variables into the positive, changing the state to exuberant (P+ A+ D+). All three values end up positive, especially the arousal (A) value which starts at 0.0 but over 3 hours' changes to 0.12, peaking at 0.17. The far-right orange box shows the vast change the PAD system can undergo during inactive time. The pleasure (P) value goes from 0.06 and drops to -0.15 when left for over 5 hours. This changes the hamster's emotional state from a positive emotion to a negative one. As each action decreases at different timings when the simulation is not active, the decrease in each value vastly differs, showing that arousal and dominance (D) only dropped 0.6, allowing them to stay positive. By the end of the day, the tester stopped playing and left the hamster in a negative emotional state.

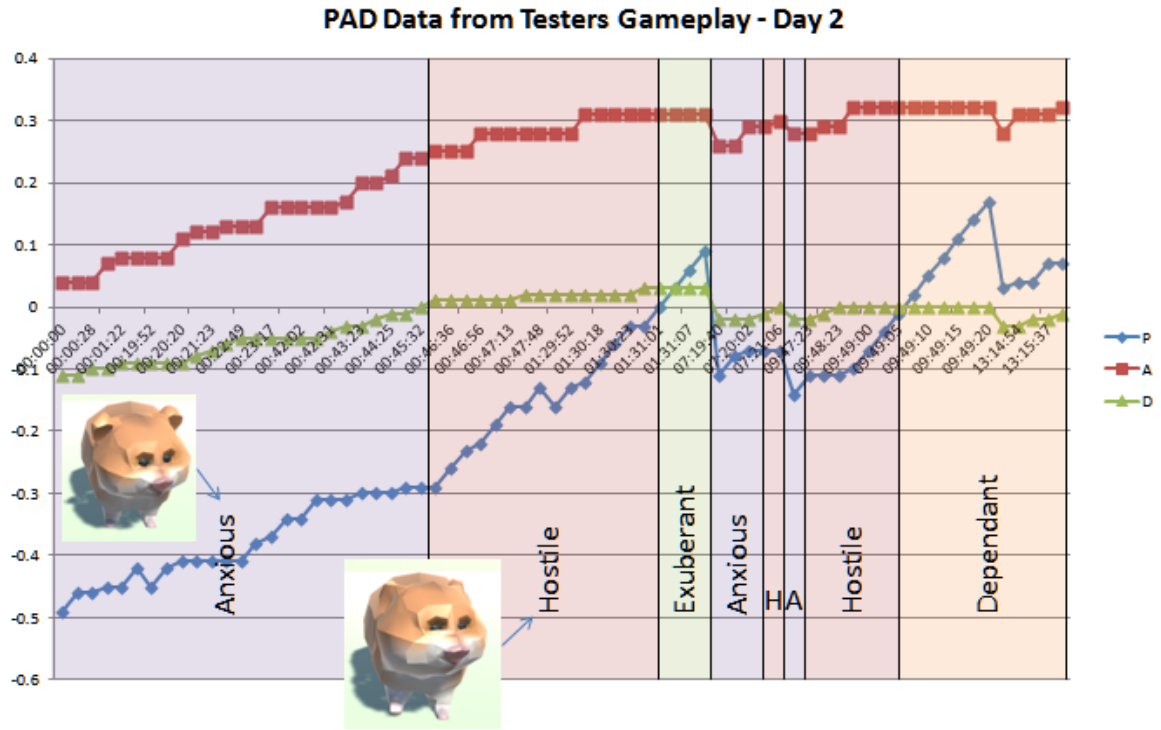


Figure 19 - Line graph showing tester two's progress through day two of testing

Figure 19 shows the progress of tester two's second day of testing. Comparing figure 18 to figure 19, each PAD value dropped significantly. Pleasure (P) dropped from -

0.11 to - 0.49, arousal (A) changed from 0.14 to 0.02 and dominance (D) updated from -0.02 to -0.1. Although the arousal values are still positive, the pleasure and dominance values kept the PAD system in a negative emotional state. This is due to the tester leaving the hamster alone for a prolonged amount of time. At this point, the hamster was in a state which shows that it is hungry, thirsty and unclean.
Figure 19 shows each of the emotional states and how the PAD system can change easily between each play time. The hamster started off the day in the negative emotional state, anxious. Over the first hour period, the player interacted with the hamster to make it happier. The increase in dominance eventually pushed the emotional state into hostile (P- A+ D+), which is an emotion in which the hamster acts angry towards the player for not interacting with it enough. The PAD emotional state eventually reached the exuberant state which showed that in the first hour and thirty minutes, the tester tried to interact with the hamster as much as possible to make it happier. Although, after it reached the exuberant state, a six-hour break occurred in which the hamster was left alone which caused the system to drop back down to the anxious state. This clearly shows the system and how much care the hamster requires to be happy. Over a two-hour period, the tester interacts with the hamster to then leave it, which causes it to drop back down to negative emotional states. The final, far right box in figure 19 shows that the tester managed to keep the hamster in the dependent (P+ A+ D-) state for a prolonged period of time, a total of 3 hours. By interacting with the hamster multiple times, the system could sustainably keep the entity in a positive state, allowing the user to sustain that over time.

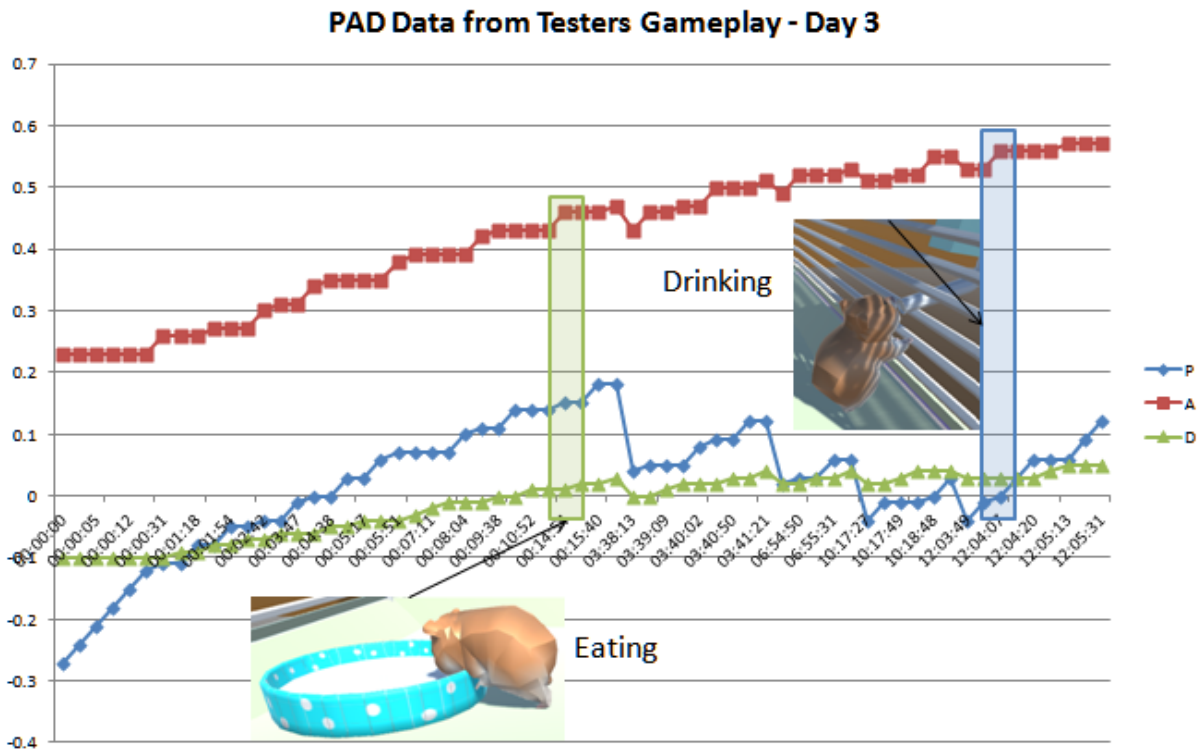


Figure 20 - Line graph showing tester two's progress through day three of testing

Figure 20 shows the data collected for tester two's final day of looking after the hamster. From the far left starting point, the data shows that the hamster has once again dropped down to a negative emotional state due to the abandonment of the entity.

Each of the data points shows an action the player has taken to interact with the hamster. Due to how the actions updating the information in the PAD system, the first six data points show that the player interacted the hamster in order to try and make it happier. Then, the tester started to allow the hamster its basic needs and to also attempt to change its negative state into a positive one. Within the first five minutes of interacting, the hamster changed to a positive emotional state and by the eleven-minute mark, entered the exuberant state. The exact change of the PAD system can be seen in figure 20, showing how certain actions will affect the hamster more drastically than other interactions.

Figure 20 additionally shows how the tester has learnt from the system over time. It is assumed that the player was able to form an understanding of the needs of the hamster at certain times to result in a change of emotions. The player managed to start keeping the hamster in a positive emotional state over a longer period compared to day one and two.

Finally, by the end of the day three testing period, the player shows that they progressed in trying to raise the hamster's happiness, continuing to interact with it even though it was in a positive emotional state. The results clearly show that they wanted to continue playing with the hamster, making sure that the entity stayed healthy and active throughout the day.

Overall, the three days of testing showed that the over time, the tester gradually started to understand what they needed to do when looking after the hamster. None of the testers were notified of how the simulation worked and were required to learn how to take care of the hamster and the schematics behind the PAD emotional state system implemented themselves. Showing that the testers learnt the system means that the simulation has an easy learning curve which allows the user to become invested in the game at a quick pace. Additionally, the information gathered shows that the tester gradually spent more time each day interacting with the virtual hamster, using the UI to know what the pet needed and making sure that it was happy during the day. Furthermore, the data points show that the user understood that if they worked on sustaining higher values in the PAD system, when they would leave the hamster alone, it would not instantly change to a negative state.

## Post Simulation Test Questions

After the three-day simulation test period was over, the data was collected from each tester and a final questionnaire was given. Each question asks about how the user felt during the test period and if the experience affected them in any way.

The first question to be asked was if each of the testers enjoyed their overall experience of the simulation. Figure 21 shows that four out of the five testers enjoyed the simulation. Even though this result does not conclude whether a bond was generated or not, the idea that a high percentage of the testers enjoyed the simulation shows that the overall user experience generated an environment where the players could enjoy themselves. Additionally, figure 22 proves this result with the question, "Will you continue playing this game after the test period?". The same results, four out of five testers replying yes, show that the simulation was enjoyable for the players and that they could have bonded with the virtual pet and want to continue interacting with it.

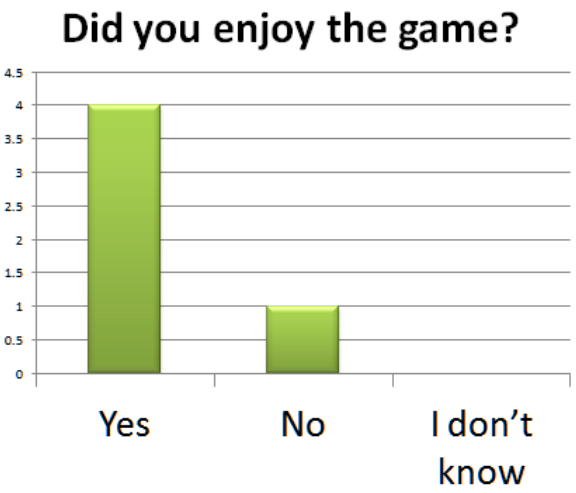


Figure 20 - Results for post test question 1

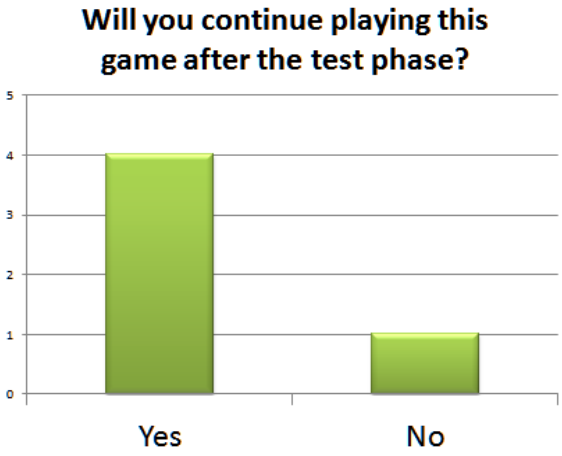


Figure 22 - Results for post test question 2

The next set of questions asked to the testers used a range of values to determine their personal answer. The range of values were shown as:

- 1 - Strongly disagree
- 2 - Mostly disagree
- 3 - Slightly disagree
- 4 - Do not agree or disagree
- 5 - Slightly agree
- 6 - Mostly agree
- 7 - Strongly agree

Allowing the users to answer questions using a range enabled them to give a more coherent answer, resulting in precise results to be determined.

When researching the idea of generating bonds between a person and a virtual entity, personal views of the applications are needed to determine if the project was a success or not. Figure 23 asks whether the testers believed the simulation accomplished its goal or not. The information shows that the majority of the testers accomplished the goal of generating the bond between them and the hamster. Figure 24 shows that the simulation worked in creating a relationship but further information is required to know the extent of the bond. How far was the tester willing to go to continue forming the bond between them and the hamster? The information provided in the next question allows the extent of the relationship to be investigated. Figure 24 shows that most of the testers felt attached to the hamster in some way. They felt that the hamster was their pet and believed that that was why they experienced the simulation in certain ways deferring from other games. By knowing if the tester felt emotionally attached to the hamster, the results of the testing can start to show the boundaries of the relationship.

Expanding on the extents of the relationship, the final two questions were looking at the play styles of the testers once they were bonded and how it affected their overall experience. Looking at figure 25, four of


Figure 23 - Results for post test question 3

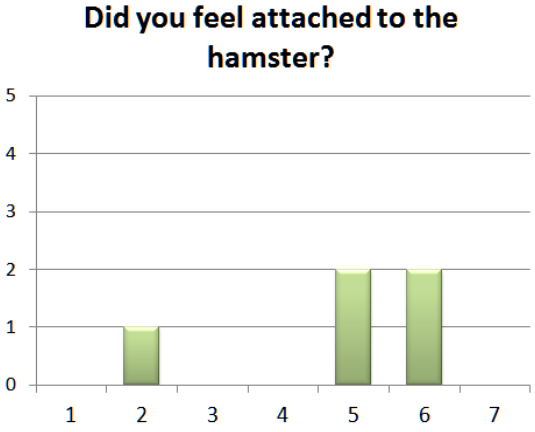


Figure 22 - Results for post test question 4

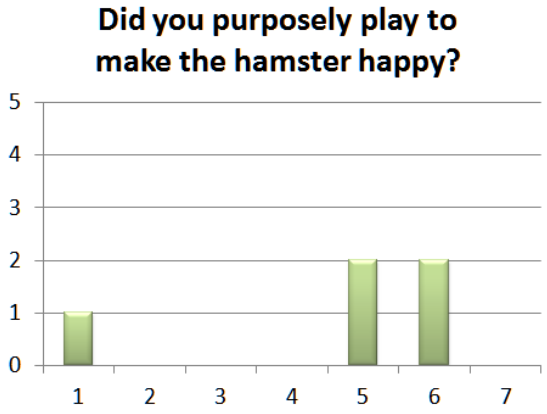


Figure 23 - Results for post test question 5

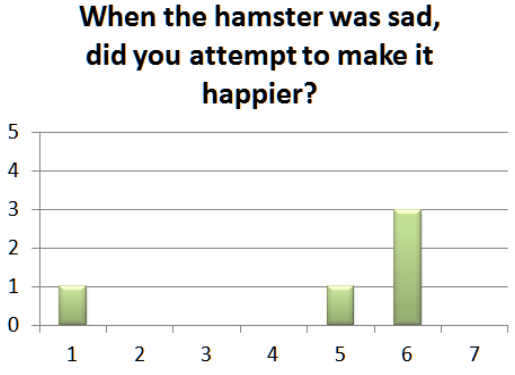


Figure 24 - Results for post test question 6

the testers answered that when playing the simulation, they would interact with the hamster to try and change its emotional state from negative to positive. They would interact with the hamster in an attempt to make it happier. In addition, figure 26 shows that if the hamster was in a negative emotional state, the testers would interact with the virtual entity to make it feel more positive. These two results underline that the testers spent their time interacting with the hamster to make it happy and content. They would keep track of the hamsters needs and feel rewarded when the pet was happy.

## Additional Information

Through the testing, certain results were unexpected and altered the overall outcome. One of the five testers did not enjoy the simulation, nor did they build a relationship with the hamster. In each of the previous results, it is clear that their personal view of the simulation was negative and that the experience was not enjoyable. When testing the simulation, the tester interacted with the hamster only three separate occasions, spanning a total in-game-time of ten minutes and thirty seconds. The information given from this tester shows that the simulation was not to their liking and that the possibility of them generating a bond with the hamster was low.

| Testers | Day 1 | Day 2 | Day 3 | Total |
|---|---|---|---|---|
| Tester 1 | 00:10:30 | 00:00:00 | 00:00:00 | **00:10:30** |
| Tester 2 | 00:12:53 | 00:17:16 | 00:20:22 | **00:50:31** |
| Tester 3 | 00:05:57 | 00:12:57 | 00:16:44 | **00:35:38** |
| Tester 4 | 00:09:31 | 00:09:20 | 00:23:04 | **00:41:55** |
| Tester 5 | 00:04:49 | 00:10:57 | 00:20:42 | **00:36:28** |
| **Average** | **00:08:44** | **00:10:06** | **00:16:10** | **00:35:00** |

Figure 257 - Total time testers spent in simulation

The data that the simulation produced allows to view and revisit the time each tester spent in the game which can tracked and then researched into. Figure 27 shows a table that depicts the time of each tester while in-game. This is divided into day one, day two, day three and a total time spent among the three days, including an average time.

In figure 27, tester one is shown to be the user who did not enjoy the experience of the simulation and stopped playing. Although tester one did not continue, testers two to five interacted with the hamster for three days and each showed progression. Figure 27 reveals that each tester gradually spent more time per day interacting with the hamster in order to tend to its needs, this excludes tester one as they did not play through the last two days and tester four spent eleven less seconds on day two, but then increased the amount of time spent during day three. The increase in time shows that each tester wanted to tend to the hamsters needs more and keep it from changing to a negative emotional state as the time progressed. The average overall time is 35 minutes which applies to the total time spent over the three days. It shows that in a short amount of time, the testers were able to interact with the hamster and build a relationship.

## Results Conclusion

During the initial questioning phase, questions about gender specific results were asked and due to the results of the simulation test and the post-test questionnaire, these can be evaluated. The results of the overall testing showed that female players who tested the simulation averaged in more play time and higher emotional state values than male testers. In addition, they answered higher on the questionnaires, showing that they developed a relationship faster and interacted more with the hamster over male testers. Furthermore, the female testers averaged more interactions with the hamster per day over the male users.

The overall results show that through the simulation and the interactions between the player and the hamster, a bond could be generated in a way that prompted the user to repeatedly return to check on the virtual pet. The game play styles changed over the three-day testing period by increasing the amount of time interacted with the hamster and the nature of interactions to keep the virtual pet content. Although the testing shows that some of the users might not enjoy the simulation, the remaining players enjoyed their user experience and showed that they built upon a growing

relationship that made them want to keep returning to check on the virtual pet to make sure it wasn't in need of any food, water, cleaning or general discomfort.

# Chapter 5 - Conclusion

In this paper, it has been evaluated on the idea that through applying the PAD emotional state model, a simulation can be created and used to generate a bond between a player and a virtual entity. The simulation in this specific example showed a virtual hamster and provided the user with an experience of looking after a pet, taking care of its individual needs to make it feel content and satisfied.

Through testing, it was visualized that a relationship between the player and the NPC did grow throughout the three-day period which had a direct influence on their game play styles caused by a desire and aim match the needs of the virtual pet. The results also brought light to the reasoning behind the fact that certain users might not enjoy the overall experience due to personal preferences or general dislike.

Both aims set for this paper were completed with reasonable results showing that a bond between a player and an entity can be formed as well as that this bond can have an impact in the players play style. All of the primary objectives were finished by the end of the project, being implemented into the simulation for testing. Although, none of the secondary objectives were finished or implemented, which can only allow assumptions to whether their completion would have caused the simulation to have a bigger impact on the testers and improved the overall test results.

A future use of the PAD emotional state model would include additional features and the expansion of the PAD model to extend the complexity and usability of the simulation. By adding more animations, sounds and UI elements, in addition to implementing more scenery and features, the PAD model could be improved to increase the likelihood of a relationship growing and keep the user interacting with the virtual pet for a longer period of time. Additionally, by improving the PAD model with additional emotional states and interactions from the player, the simulation will be able to increase the realism of the hamster to improve the believability of the virtual pet and its environment.

In conclusion, the project succeeded in examining how emotional bonds between virtual pets and players are created and how, with the use of emotional state models, these bonds can affect a user’s game play style and overall interactions with the

simulation. The results of the primary objectives showed justifiable reasons and explanations to how and what extend the game play changed when a bond was created and sustained. The simulation created a user experience that was described as “enjoyable and fun”, allowing players to take care of a virtual animal in multiple ways and with several actions pursuing the overall goal to make the entity content and happier.

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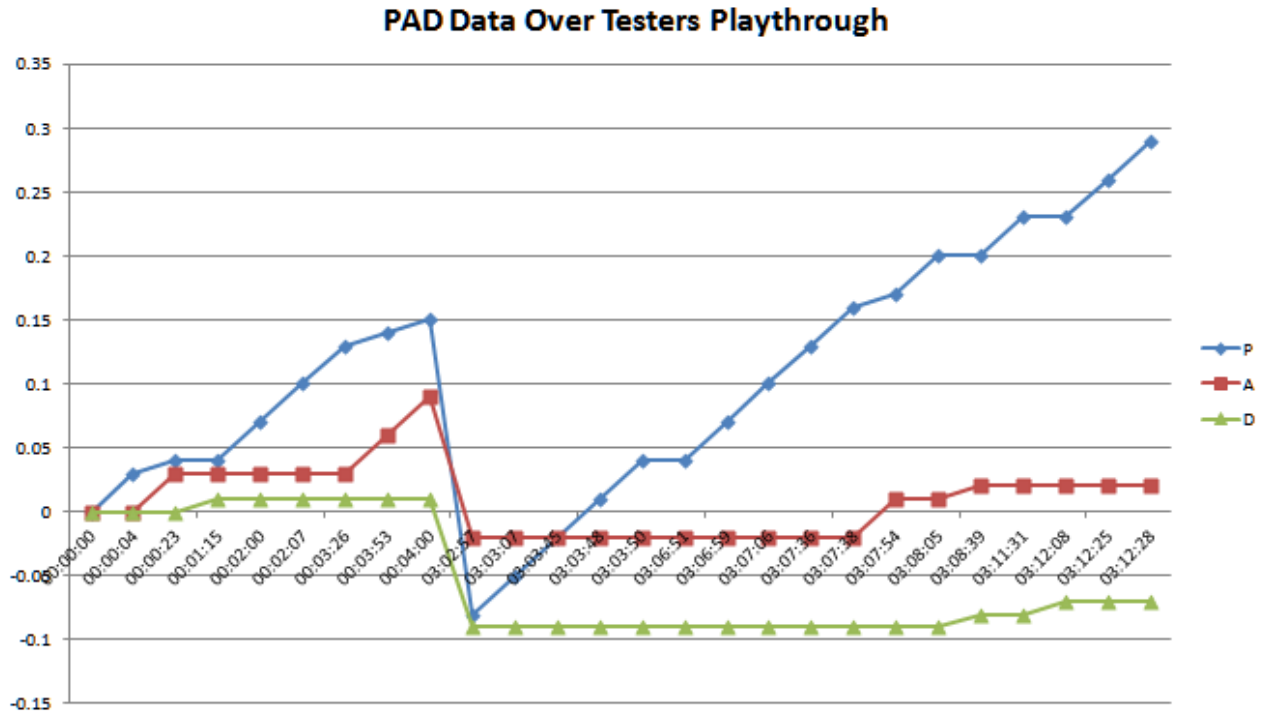
# Figure List

# Appendices

## Tester 1 Day 1 Results

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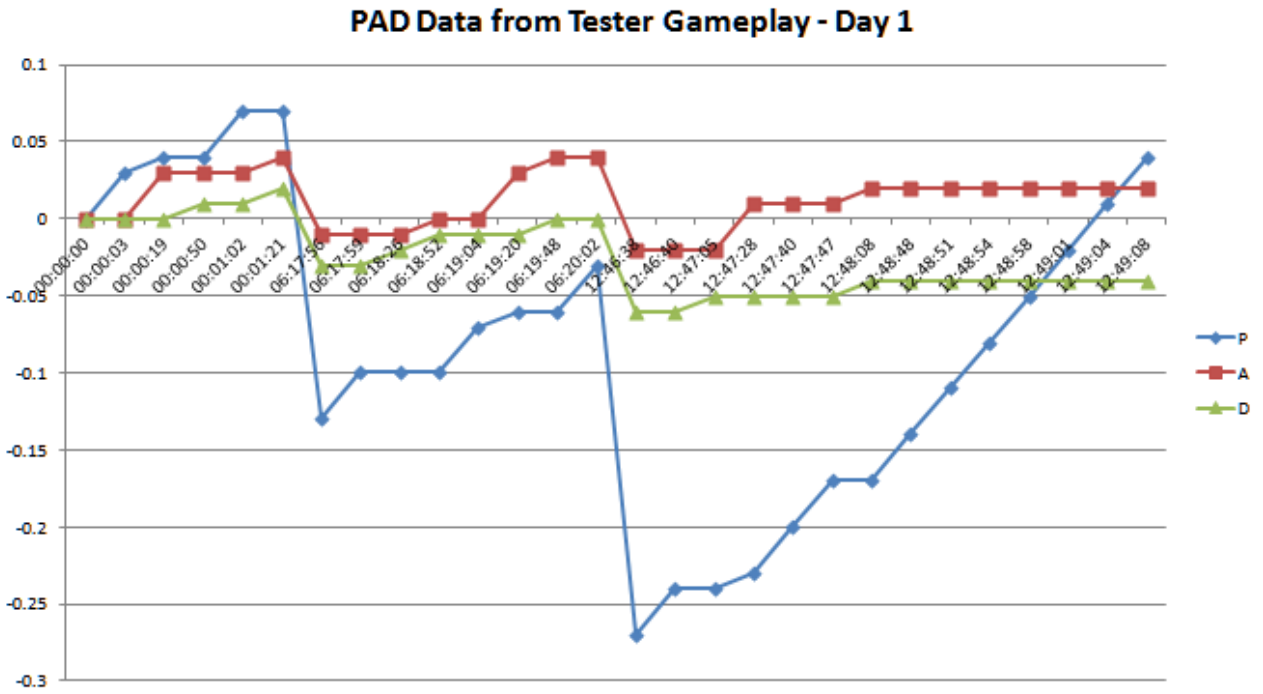
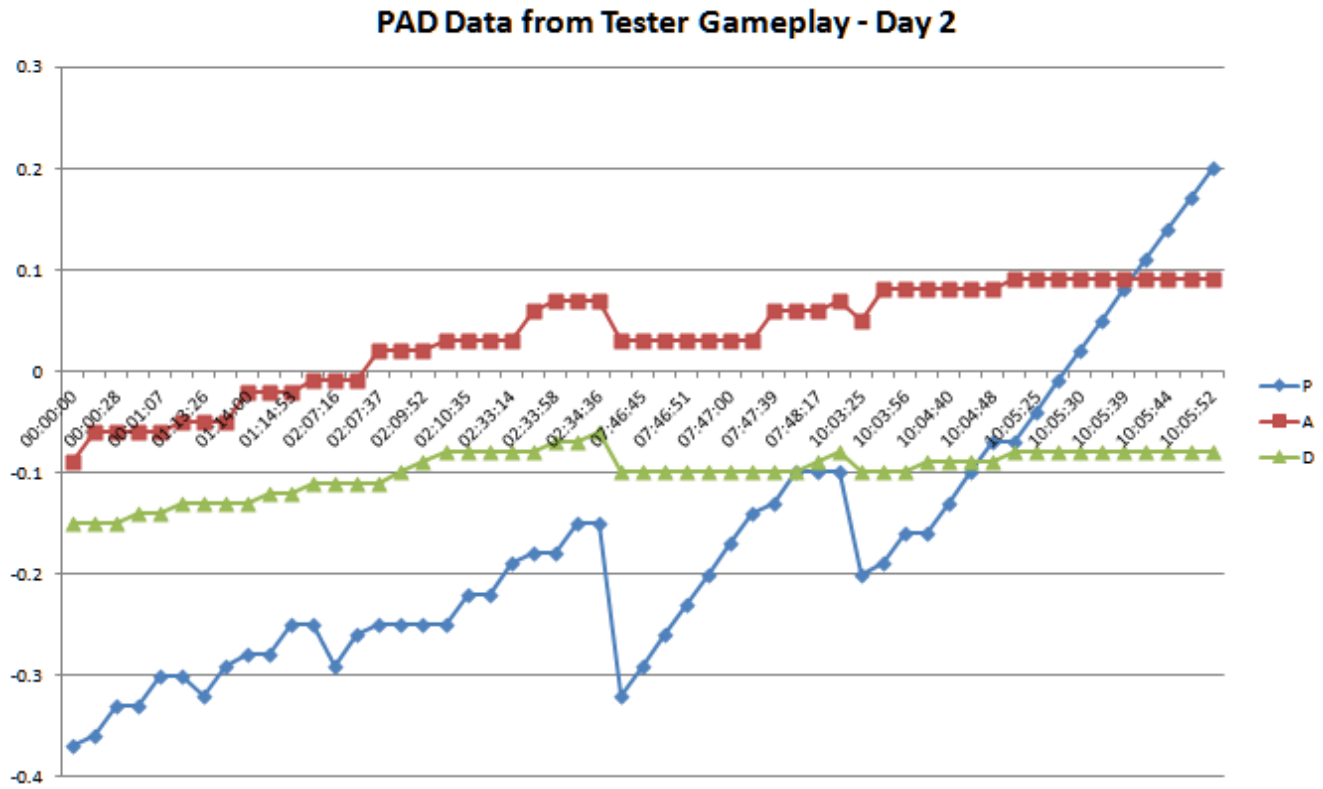
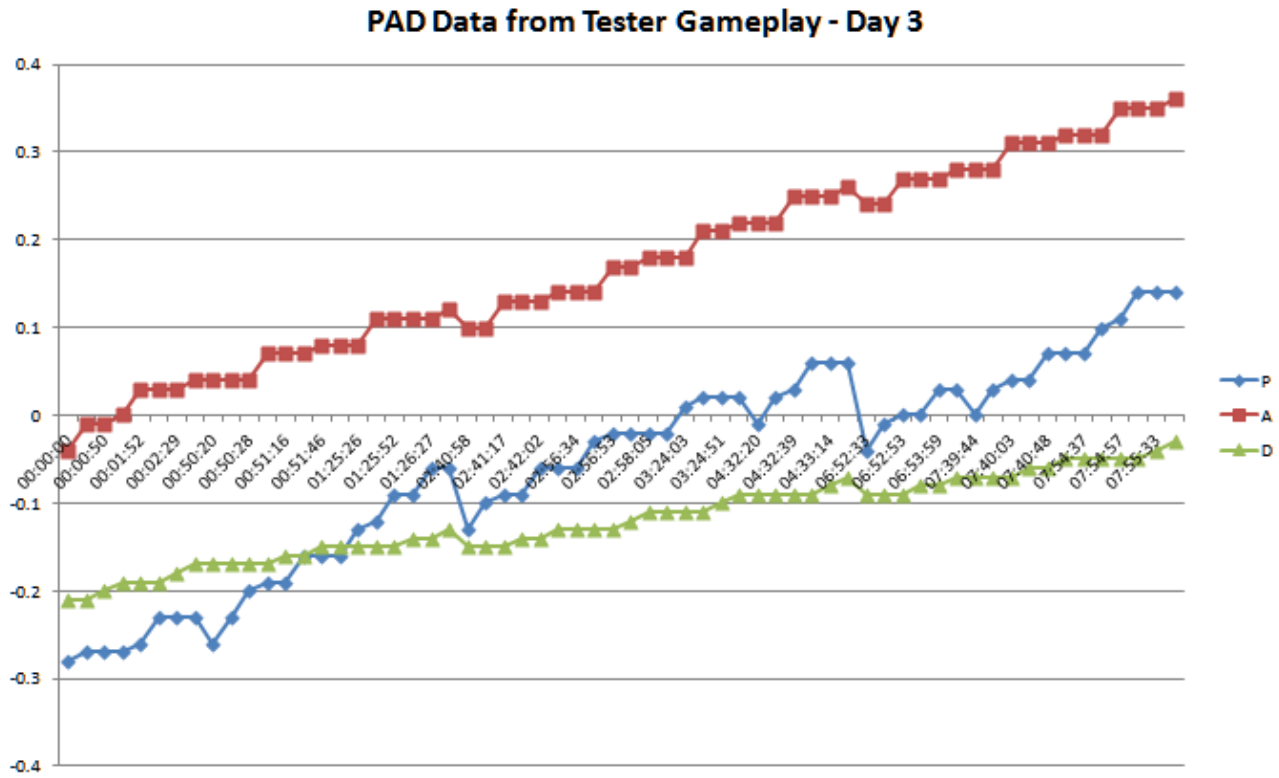


**Tester 3 Day 2 Results**




**Tester 3 Day 3 Results**



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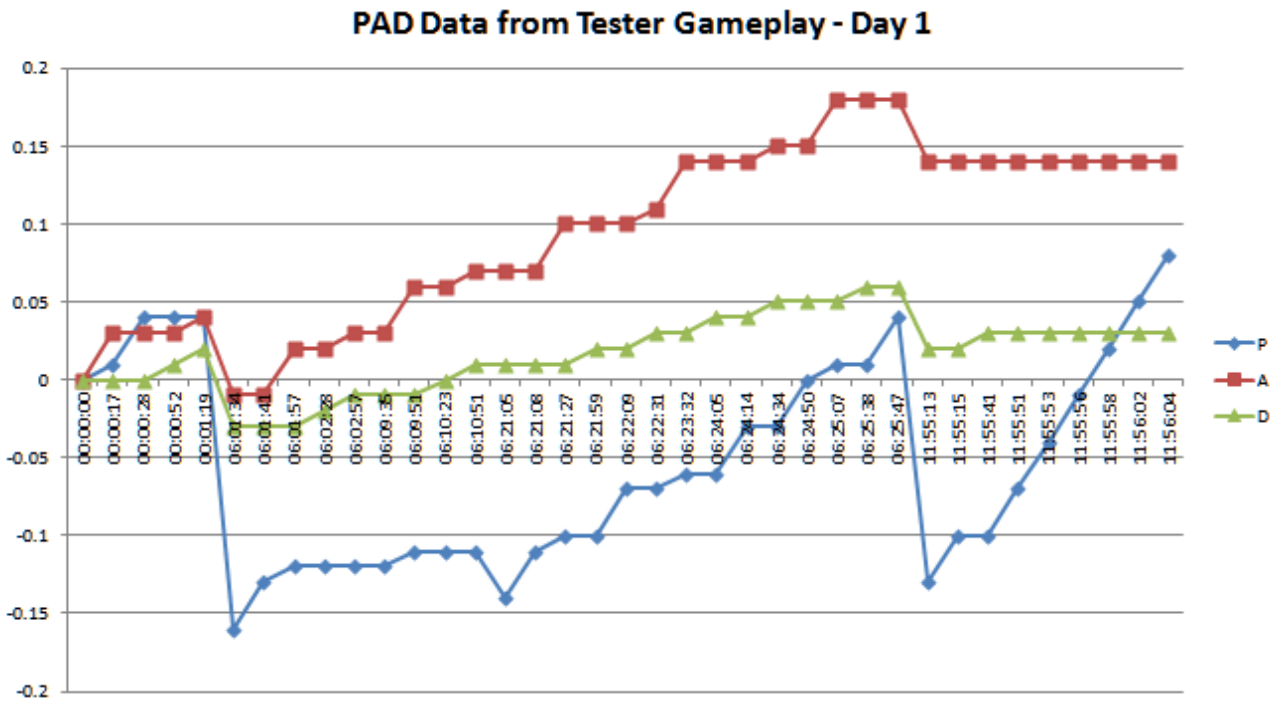


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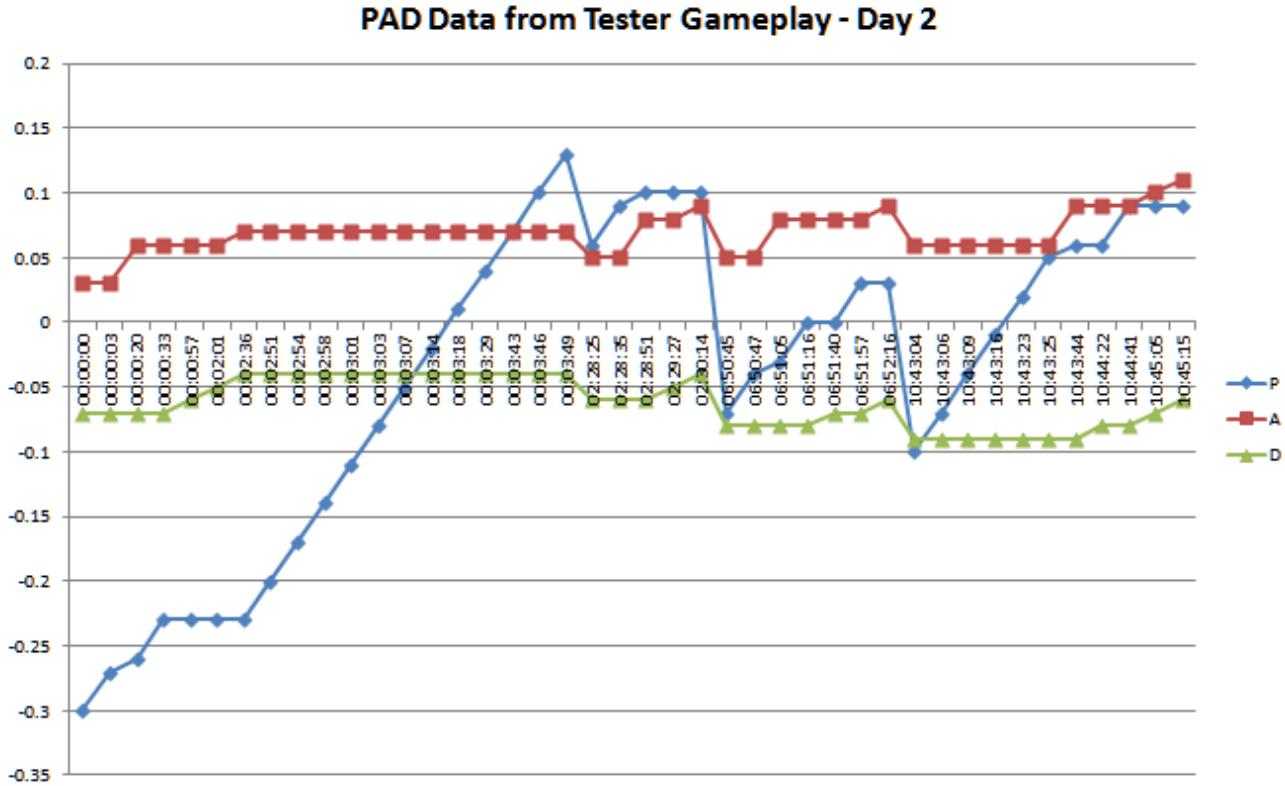

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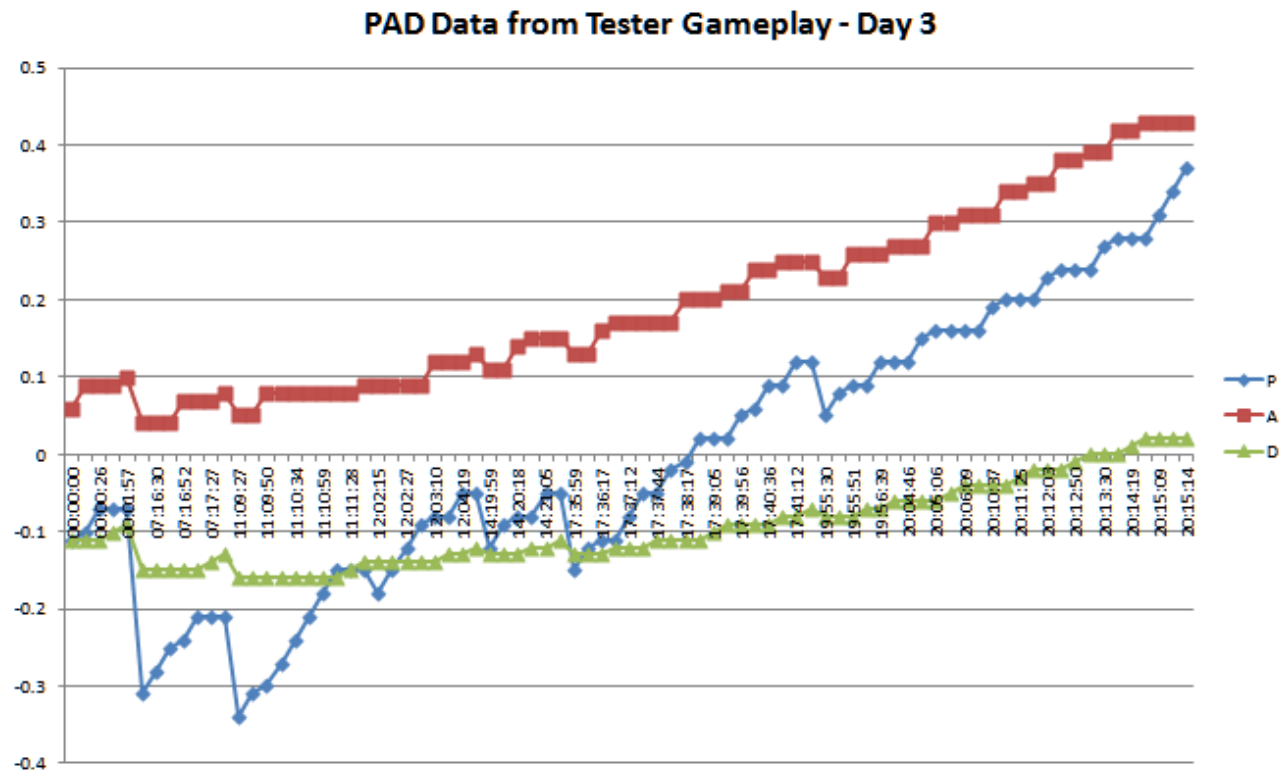


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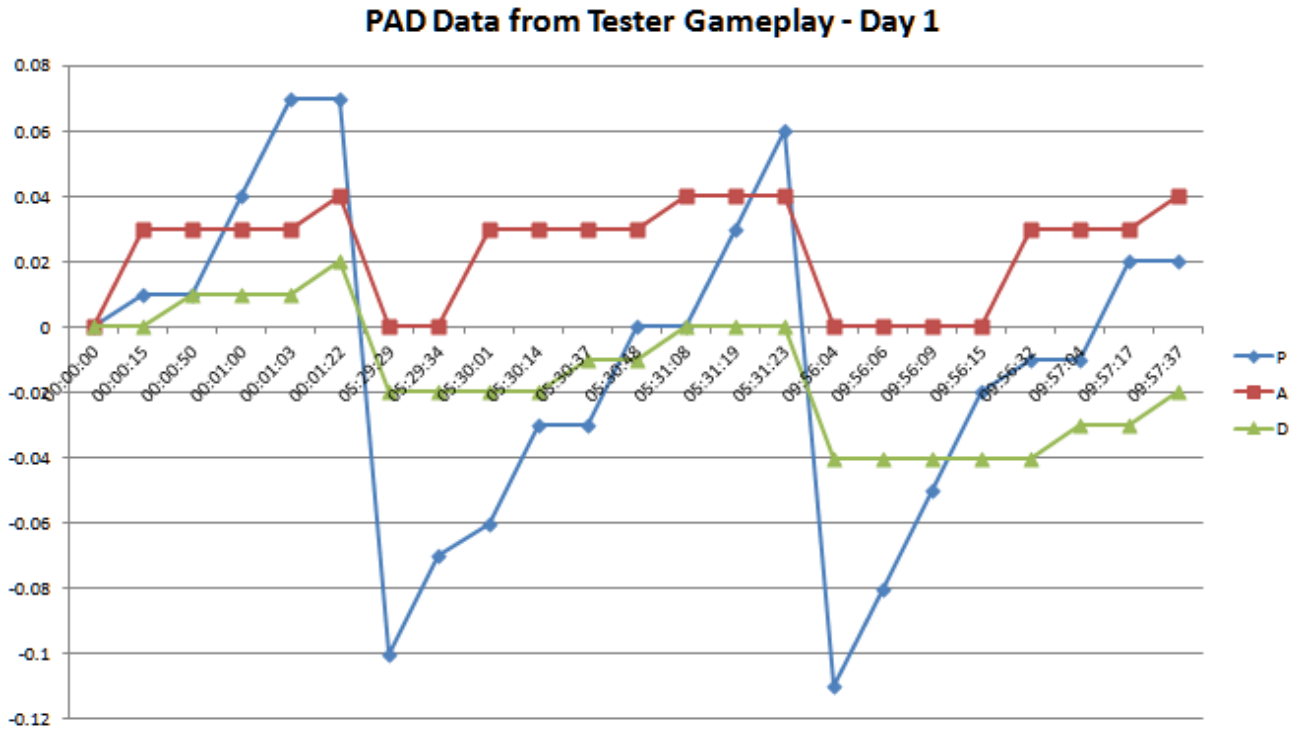

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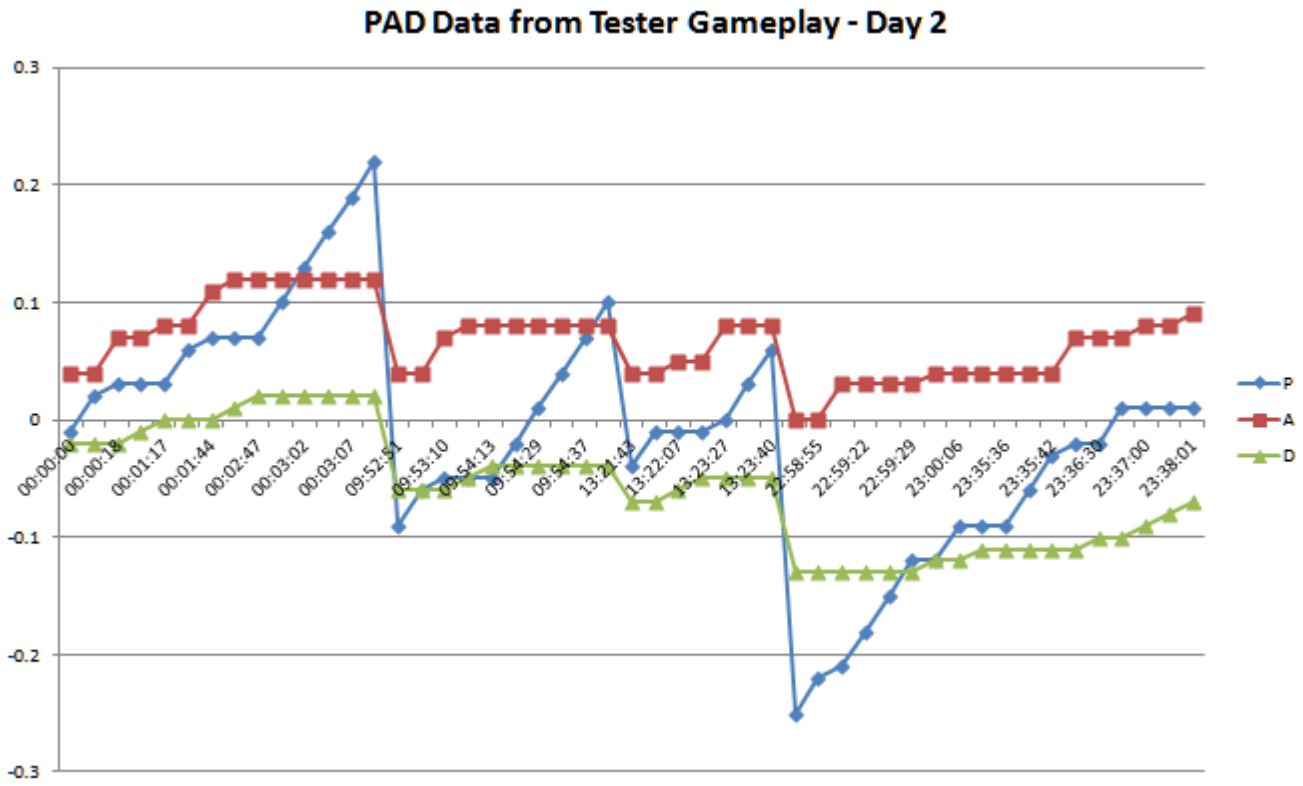


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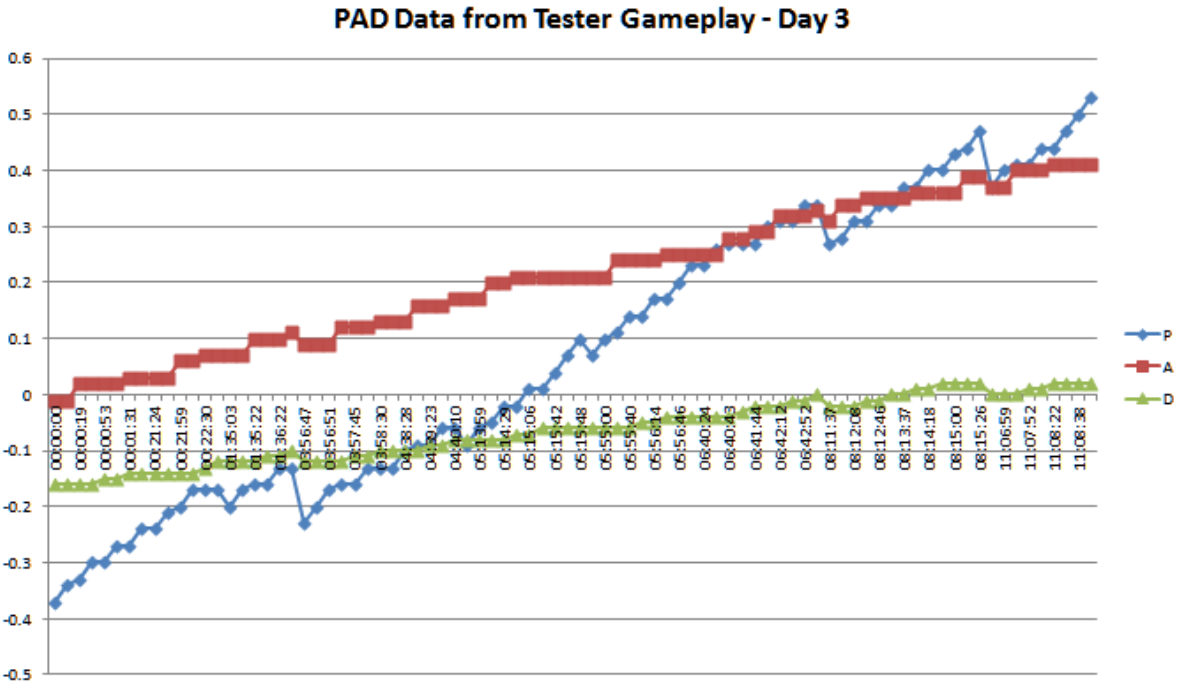

# Research Ethics Checklist

| | |
|---|---|
| Reference Id | 13667 |
| Status | Approved |
| Date Approved | 30/01/2017 |

## Researcher Details

| | |
|---|---|
| Name | Connor Fletcher |
| School | Faculty of Science & Technology |
| Status | Undergraduate (BA, BSc) |
| Course | BSc Games Programming |
| Have you received external funding to support this research project? | No |

## Project Details

| | |
|---|---|
| Title | An examination of how artificial pets affect a player's emotion and influence behaviour within a game |
| Proposed Start Date of Data Collection | 06/02/2017 |
| Proposed End Date of Project | 20/02/2017 |
| Supervisor | Fred Charles |
| Approver | Fred Charles |

| |
|---|
| Summary - no more than 500 words (including detail on background methodology, sample, outcomes, etc.) |

| |
|---|
| Companions within video games have become a common component within AAA title games. By having a non-playable character (NPC) follow you around, it allows the game to offer handicaps to the player and help them throughout their journey, ranging from combat to carrying capacity. Another aspect that companions bring to the game is loyalty and story which can entice the player into feeling a bond between the two. This can lead to feelings of friendship and companionship, which can create a need to play and protect the NPC throughout the game, justifying different in-game choices that may affect the companion. This project will determine how these emotional bonds are created and how they can change the way the player perceives the game.To replicate this bond, a game will be designed to create a simulated experience that requires the player to care for a common house pet. The house pet will need cleaning, watering and feeding to become healthy. The game will be used to test whether the player can grow a bond between the two and how that would affect their overall view of the game and the pet. |

## External Ethics Review

| | |
|---|---|
| Does your research require external review through the NHS National Research Ethics Service (NRES) or through another external Ethics Committee? | No |

## Research Literature

| | |
|---|---|
| Is your research solely literature based? | No |

## Human Participants

| | |
|---|---|
| Will your research project involve interaction with human participants as primary sources of data (e.g. interview, observation, original survey)? | Yes |
| Does your research specifically involve participants who are considered vulnerable (i.e. children, those with cognitive impairment, those in unequal relationships—such as your own students, prison inmates, etc.)? | No |
| Does the study involve participants age 16 or over who are unable to give informed consent (i.e. people with learning disabilities)? NOTE: All research that falls under the auspices of the Mental Capacity Act 2005 must be reviewed by NHS NRES. | No |
| Will the study require the co-operation of a gatekeeper for initial access to the groups or individuals to be recruited? (i.e. students at school, members of self-help group, residents of Nursing home?) | No |
| Will it be necessary for participants to take part in your study without their knowledge and consent at the time (i.e. covert observation of people in non-public places)? | No |
| Will the study involve discussion of sensitive topics (i.e. sexual activity, drug use, criminal activity)? | Yes |

| | |
|---|---|
| Are drugs, placebos or other substances (i.e. food substances, vitamins) to be administered to the study participants or will the study involve invasive, intrusive or potentially harmful procedures of any kind? | No |

| | |
|---|---|
| Will tissue samples (including blood) be obtained from participants? Note: If the answer to this question is 'yes' you will need to be aware of obligations under the Human Tissue Act 2004. | No |

| | |
|---|---|
| Could your research induce psychological stress or anxiety, cause harm or have negative consequences for the participant or researcher (beyond the risks encountered in normal life)? | No |
| Will your research involve prolonged or repetitive testing? | No |
| Will the research involve the collection of audio materials? | No |
| Will your research involve the collection of photographic or video materials? | No |
| Will financial or other inducements (other than reasonable expenses and compensation for time) be offered to participants? | No |

| |
|---|
| Please explain below why your research project involves the above mentioned criteria (be sure to explain why the sensitive criterion is essential to your project's success). Give a summary of the ethical issues and any action that will be taken to address these. Explain how you will obtain informed consent (and from whom) and how you will inform the participant(s) about the research project (i.e. participant information sheet). A sample consent form and participant information sheet can be found on the Research Ethics website. |
| The game will include a aspect where the house pet can die. This could possibly upset the participants but they will be warned of the possibilities of this before any testing is conducted. |

## Final Review

| | |
|---|---|
| Will you have access to personal data that allows you to identify individuals OR access to confidential corporate or company data (that is not covered by confidentiality terms within an agreement or by a separate confidentiality agreement)? | No |
| Will your research involve experimentation on any of the following: animals, animal tissue, genetically modified organisms? | No |
| Will your research take place outside the UK (including any and all stages of research: collection, storage, analysis, etc.)? | No |

| |
|---|
| Please use the below text box to highlight any other ethical concerns or risks that may arise during your research that have not been covered in this form. |
| |