



# Abertay University

## **Is it Possible to Show Adaptive Behavior in Followers in The Elder Scrolls V: Skyrim?**

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# ABSTRACT

This research endeavours to explore the possibility of showing adaptive behaviour in NPCs present in the world of Skyrim. A particular faction of these NPCs can be recruited by the player to accompany them on adventures across the game world. These NPCs however, pay little to no attention to their surroundings or the people they come into contact with. After some preliminary research into the possibility of creating an additive application, otherwise known as a MOD for Skyrim, the researcher decided to attempt explicitly showing adaptive behaviour within these Follower NPCs found in Skyrim.

A proprietary application known as the Creation Kit is a software, specifically designed to allow the creation of Mods for many games, one of them being Skyrim. In order to begin creating such a Mod, the researcher studied how the unique AI framework of Skyrim, otherwise known as Radiant AI works and created a completely new NPCs which was added to the follower faction. Through the interface of the creation kit it was given day to day routines which worked on Radiant AI.

Having done this, the researcher could now add the adaptive behaviour related functionality by way of Scripting which was done in the proprietary scripting language known as Papyrus. The NPC was then tested by 12 volunteers and the data was collected using a questionnaire. The results of the testing process were collected and then evaluated. The evaluated results appeared to suggest a positive trend towards very clearly observed adaptive behaviour, this suggesting a degree of success answering the research question. A lot of useful feedback was also collected which allowed in shaping further testing possibilities and perhaps expanding the capabilities of the Mod as well.

**Keywords:** Artificial Intelligence, NPCs, Creation Kit, Papyrus, Behaviour Trees.

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# 1. Introduction

One of the key elements to creating a game world is having it populated with characters and creatures which feel alive. What this means is that they would appear to behave in a manner that would be believable for the player to imagine.

A good example of this may be that if you have cats in your game world, and the premise of your game world is a life like presence, then it would be very odd to see cats walking around on 2 feet instead of 4. There is obviously an exception to this if the cats in this game world are some form of humanoid species, in which case it would be odd if they weren't walking on 2 feet.

It is safe to assume that there would be many characters and creatures in a game world and having to code their behaviours would take very long. In order to counter this, AI is used. Video Games have been using AI in order to manage and control the Non-Playable characters and the game world for as long as they have existed. It is simply a very efficient way of controlling a large number of elements. Due to this many different techniques of AI have been explored in order to implement and see which one would work best. Some of these fine techniques are Finite State Machines and Decision Trees. This research will be discussing how a version of Decision Trees, better known as Behaviour Trees will work to answer the problem statement.

Before discussing the project matter further, it is important to lay out some aims and objectives of this research.

## 1.1. Aims

The aim statement of this research is to explore the possibility of showing adaptive behaviour in a controlled, yet random manner in an already existing AI framework, specifically the AI framework of Skyrim. The Elder Scrolls V: Skyrim has a set and very dominant AI framework in place known as the Radiant AI which controls many different elements of the game, which makes it difficult to introduce a completely foreign element. Keeping this in mind, the researcher aims to explore the possibility of creating some sort of dynamic behaviour within these limitations. This would allow the exploration of the possibilities of expanding what existing NPCs in the game world could be made to do.

## 1.2. Objectives

In order to achieve this aim, the researcher will progress under the pretence of the following objectives:

1. Explore the Various AI Techniques used in Videogames.
2. Discuss which AI Technique would best fit in the scenario set by the research question.
3. Examine the numerous ways additions could be made through the creation kit.
4. Study how the changes made are actually implemented in-game and therefore, to what extent these changes are allowed.
5. Critically evaluate, by way of statistical instruments the success of the project.
6. Suggest possible improvements that can be made to the project in the future.

In order to fulfil said objectives, the first thing to make note of, for the purpose of this research is Behaviour Trees. Behaviour Trees are simply decision trees with such choices that they allow the creation of worlds and NPCs which would appear to express heuristic behaviour as one would experience in real life. Behaviour trees allow for the showcase of routines in humans which are perceived to be more human such as Sleeping, Eating etc. (Colledanchise Michele, 2016)

Some of these NPCs which may fall under the category of Follower or Party member. A follower is a unique type of NPCs that can be asked to accompany you in the game world. They can fight alongside you and can be ordered to carry out menial tasks. Due to this, followers will obviously have more interaction with the player therefore their AI would have to be a bit more complex than the usual populace of the game world.

Some of the best examples of these followers are as follows:

### 1. Elizabeth from Bioshock Infinite

The Follower NPC in Bioshock Infinite is called Elizabeth. the AI designed to determine the way she acts is a custom handmade for her especially and can't exactly be copied over onto other NPCs in the game. Her AI was designed to show emotions and act akin to a curious child exploring new things as she is also used as a medium for the player to see the game world through the eyes of. her actions build towards her personality and character in the game to drive the plot and provide support to the protagonist.

### 2. Ellie from The Last of Us

The last of Us also has a similar supporting NPC for the protagonist named Ellie. While her duties may be somewhat similar to that of Elizabeth however, the way her AI reacts to her surroundings is completely different. She is very aware of the dystopian world she lives in and plays a ruthless game of survival. (Dyckhoff, M.)

### 3. Companions or followers present in Skyrim

The AI designed for followers in the elder scrolls videogames are the backbone of this research. While they don't compare to the resourcefulness and perceived emotional expressiveness of Ellie and Elizabeth. The AI that was designed for them is a strong foothold for what followers would

be expected to do in an open world RPG videogame. In Skyrim alone, you can choose from assorted followers you meet on your adventures peppered across the map, with different levels of interactions available. If they were compared, the elder scrolls AI would prove quite primitive with barely any emotions. However, the AI, namely Radiant AI designed for when Oblivion first came out, has catered to the countless possible outcomes in such a massive world.

The best way to explain the above statement would be to note some of the key behaviours one would expect to see in the NPCs of RPG titles.

1. Wake up and have breakfast
2. Go to work
3. Come back home
4. Have dinner and Sleep

These are just some of the actions which would be expected of the NPCs. this is what makes the Radiant AI so good that it allows the making of these rudimentary routines with so many variations that they would appear to be different for each NPC.

This obviously begs the question as to how is this AI monitored? Due to the vast majority of possible outcomes, the programmer can only do so much to account for every result. To combat this issue, the Radiant AI had to ultimately be limited in the coming instalments of the titles it was used in such as The Elder Scrolls V: Skyrim. (Anon., 2012-01-29)

The drawback of this limitation can be seen in the generic nature of most followers in Skyrim. They are confined to their routines and scripted encounters (if any) and appear to have no character of their own when following the player around.

The same cannot be said for the other two examples, that of Elizabeth and Ellie. While they may appear to have superior AI, it is actually confined to the level by level progression of the game which unlocks other parts of the world and thus adds to their AI. This However is not the case with Skyrim as the entirety of the world is open to the player from the first moment. Therefore, it is difficult to determine what player would do and thus the AI can't account for it appropriately.

This raises the question of whether it may even be possible to create such human like followers in RPG titles such as Skyrim at all? Even to a much smaller degree as in behaviour specific to just the player or even just one faction in the game world?

This research attempts to answer that question by way of creating a custom follower using the Bethesda Creation Kit. The researcher creates a hybrid system which takes the pre-existing Behaviour Trees set up in Skyrim and combines them with a Finite State Machines which is created by way of scripts running on the custom follower.

The Bethesda Creation Kit is a framework provided by Bethesda Softworks to allow for modification and creation of new content that can be to their videogames. It uses the Papyrus Programming (Scripting) language which was created specifically for this application.

An ideal scenario for the research is to have two or three sets of personalities with one allocated by default to the follower. Based on the interactions with a specific person in the game, we observe if the personality shifts towards another predefined set or not. the shift in personalities proves the possibility of having adaptive behaviour in Followers in Skyrim. Additional User testing is done to see how this addition affects the overall feel of the game. Due to the abstract nature of the question, the results are expectedly subjective. A Turing Test is carried out to determine how the AI is expected to different scenarios.

## 2. Literature Review

This section will encapsulate the current research that have been carried out on the subject area and also provide further context to the research question. The flow of the section will be such that it will first draw out the basic information the researcher is required to have regarding the use of different AI techniques in the videogames industry specifically, the section will then continue to elaborate the different AI techniques used such as Finite State Machines (FSMs), Rule based Systems and Decision Trees which are more commonly known as Behaviour Trees in this corner of the industry. The Section continues to discuss how these AI techniques have been implemented in different genres of videogames such as The Last of Us, Half Life and Bio-shock. The researcher then goes on to segue into explaining one of the most ground-breaking implementations of the Behaviour Trees, better known as Radiant AI. Radiant AI is what primarily controls a major part of how the game worlds of the infamous RPG titles Fallout and The Elder Scrolls operate, as The Elder Scrolls V: Skyrim is one of The Best Selling Games of All time (SUELLENTROP, 2016).

### 2.1. Videogames and AI

When creating giant worlds in video games rich and brimming with life, it is almost inevitable to use some form of AI to create the illusion of people going about their lives in these worlds. It adds another layer of complexity and adds to the façade of building up the world.

AI has not only become the primary way to execute this, but also the most efficient way to do this. It is because AI allows to create somewhat realistic routines for NPCs (Non Playable Characters) without the hassle. Various genres of videogames have used different techniques based off of what they require. (G. Pihlgren, 2016)

Generally, an AI system is created based off of the requirements. Next the NPCs or any other element of the game which needs to be controlled by this AI is set up and linked to it. (David Bourg, 2014). For instance, you could design a base routine and set it for all the NPCs in game. Given that the set routine would have variables which can be given random values, essentially all NPCs would be doing the same thing, but at different times and using different items and have different destinations, this would massively change the final outcome and result in something that would look like a busy town with people going about their daily lives.

In order to determine the best suited AI approach for a particular task or Videogame, some proprietary research is carried out, which would aim to answer the problem in the best way possible. Based on the findings, solutions with different AI techniques are determined and then finally other constraints such as time, efficiency and complexity define which solution would ultimately be pursued. In some cases, developers may choose to create a hybrid solution where two or more AI techniques may be combined to create the desired results. (David Bourg, 2014) (Colledanchise Michele, 2016)

## 2.2. AI Techniques used in Video Games

Depending on the desired result, there are numerous AI techniques that can be found in videogames, namely swarming techniques, pathfinding techniques and even neural networks. While swarming techniques may be incorporated to control how animals or creatures which move in packs behave, their other use may also be to control how humans may behave in threatening circumstances (Cunha, 2015). Moreover, pathfinding techniques may be used in racing games to control how components in a race drive (Wang and Lin, 2010). It takes quite some time to train a neural network which is why it is uncommon to use it in games, however games like Supreme Commander 2 have incorporated it in calculating the fight or flight responses for their bots (Robbins, 2017). Other Techniques include FSMs, Decision Trees and Behaviour Trees which are discussed in further detail.

### 2.2.1. Finite State Machines (FSM)

FSM are fairly easy to program and can produce fairly good looking results. However, when it comes to rather meticulous routines and task layouts, they can get messy and complicated pretty fast.

Usually FSMs (Finite State Machines) are seen being used pretty commonly in video games. The ideal example of how a Finite State machine may be used in videogames can be that of a Town Guard. A typical town guard will have a daily routine of patrolling the streets. If a crime is committed, we would require the patrolling guard to take notice of it and if the culprit is nearby then apprehending him and if he isn't, then look for him. After a predefined amount of time, stop looking and return to patrolling. These actions can be best handled by having each situation as a different state. Some variable would be manipulated to allow for the switching of the states.

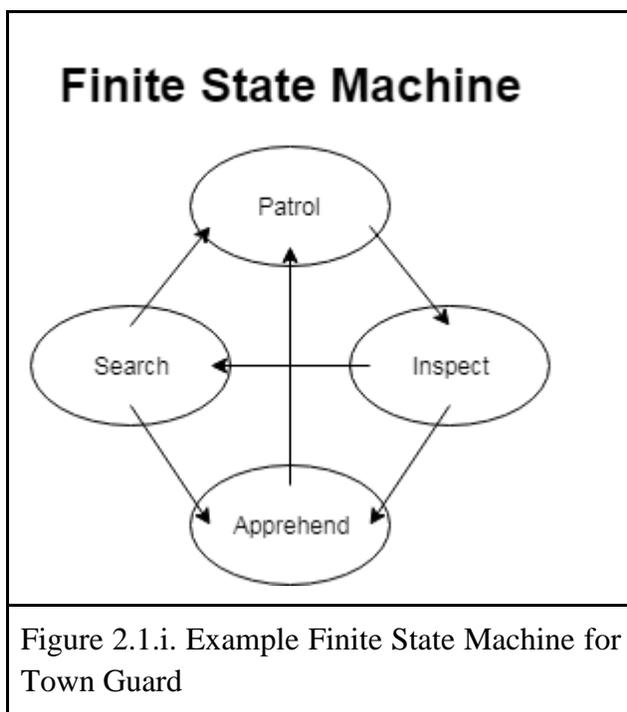


Figure 2.1.i. Example Finite State Machine for Town Guard

A few examples of games that have incorporated FSMs are

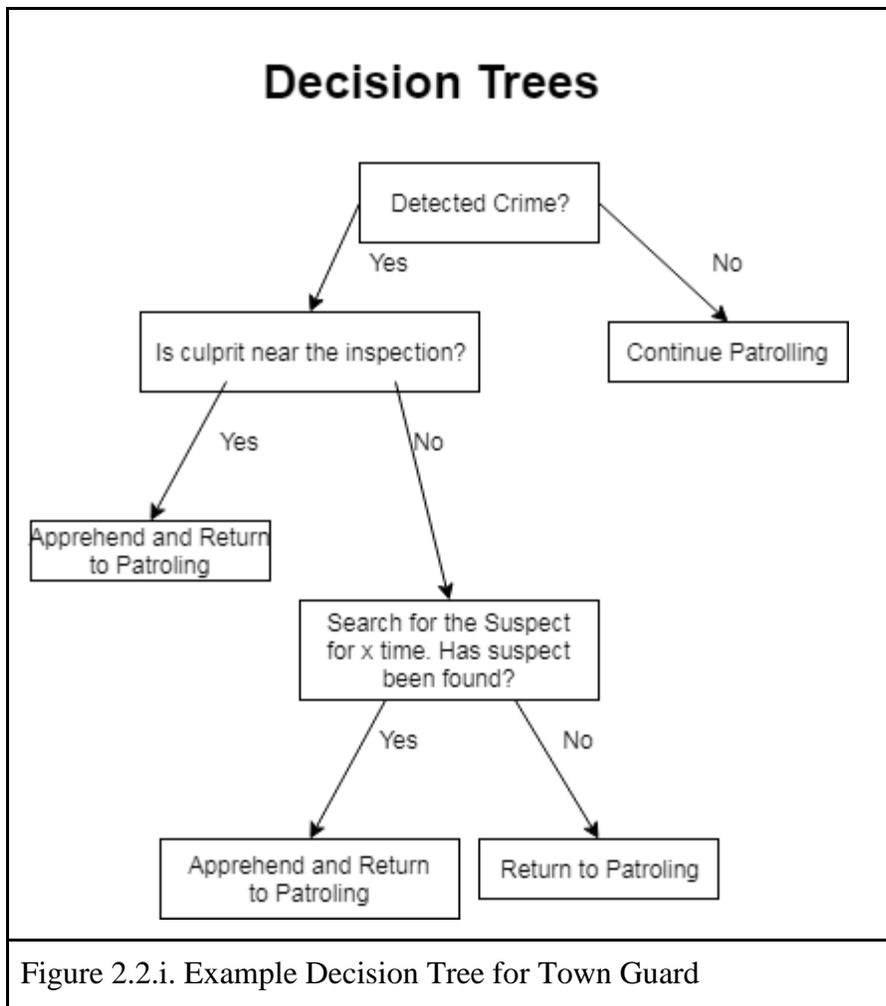
1. Super Mario (Video Games are Finite State Machines, 2017)
2. Thief 3 (Raim, 2005)

### **2.2.2. Decision Trees**

Another technique more commonly being used is Decision Trees.

A decision tree takes on the form of tree like graph which takes into account sequence of actions that can take place and their consequences. It is an excellent tool for situations where the deciding factor is a conditional statement. In Decision Trees, each internal node acts as a test on each of the attributes of the problem statement. The branches signify the possible number of outcomes and each node is then a class. If we were to follow a decision thread from root to the last node, the path would represent the classification rule of that decision (Brid, 2018).

Tree based learning algorithms such as decision trees are exceptional at handling nonlinear and linear situation. They learn quite quickly and can provide good solutions. This is why they are most commonly adapted in the implementation of overarching AI in videogames. They can be easily adapted to solve a variety of problems (Brid, 2018).



One of the game's most commonly known for using Decision Trees is F.E.A.R. (En.wikipedia.org, 2019).

## 2.3. Behaviour Trees

As mentioned earlier that Decision trees can be very easily adapted, one such adaptation is called Behaviour Trees.

A Behaviour Tree (BT) is a mathematical model used to define decision trees they have a keen strength in being able to create complex tasks through a well-defined hierarchy of simple tasks. Behavioural Trees are a very powerful tool and mostly prevalent in the games industry. (Grant & Lardner, n.d.)

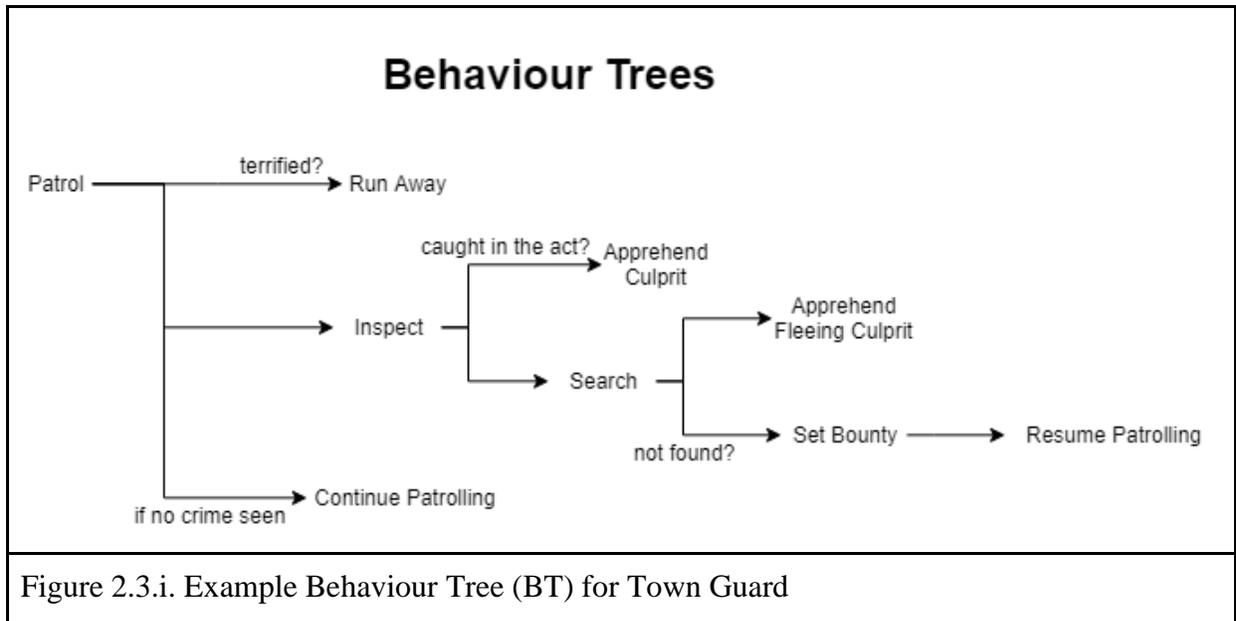


Figure 2.3.i. Example Behaviour Tree (BT) for Town Guard

A great Benefit of Behaviour Trees is that they can be designed in such a way that they can control a large number of elements in the game world without having to create multiple separate trees. the best example for this case is that of towns people. every NPC in Town would have a few proprietary routines they would follow such as eating, sleeping, working. a behaviour tree could be designed with these attributes defined as variables. There would only be one behaviour tree which would determine how these routines would play out, and since the attributes are variables, multiple instances of the same behaviour tree could be created with different values for each variable. The result of this would be that all the townspeople would using different instances of the same behaviour tree and thus in theory, they would all be doing the same thing but it would not appear so as the attributes are variables and we could quickly create the illusion of a busy town with its residents going about their lives.

Bethesda Softworks took the Concept of Behaviour Trees a step further and created something called Radiant AI. This system was created for the purpose of building up the worlds of some of their best-selling videogames of all time, Namely The Elder Scrolls Saga and The Fallout Series.

Behaviour trees are what are being used in The Elder Scrolls V: Skyrim. These Behaviour Trees are called AI packages. Each AI package governs a routine which would be carried out by NPCs in the game world. This is good practice as:

1. Behaviour Tree Routines will not conflict with other elements present in the game world such as how the weather is manipulated etc.
2. These routines can be used as building blocks and would allow more interchangeability to create completely new behaviours in NPCs with existing assets.

This doesn't go to say that using a different AI technique would be wrong or bad. It is definitely possible to use a Finite State Machine or any other technique alongside behaviour trees. In Fact, most video games these days use some sort of a hybrid system (Rasmussen, 2018).

## **2.4. Radiant AI**

Radiant AI is a sophisticated piece of technology which comprises of a number of different Routines Controlled by Behaviour Trees. it is primarily used to determine how NPCs in the game world to act and go about their lives. The Radiant AI technology comprises of 2 main parts

### **1. Radiant AI**

This part revolves around determining the behaviour and actions of the NPCs. Essentially, each NPC may be given a certain set of roles like going to work or eating and then the AI is left to decide the best way to achieve them. This has a huge benefit as it then allows developers to create large scale worlds without having to individually script every NPC in game.

### **2. Radiant Story**

This part dynamically distributes quests around the map. It sees and puts random quests in parts of the map the player may not have discovered yet and connects them to earlier quests at times as well in order to provide a cohesive experience. This is an efficient technique since it would take a lot of time and effort to individually program and place every quest on large scale maps. (Anon., 2012-01-29) (Anon., 2012-01-29)

Bethesda has not been very forthcoming in terms of how exactly it works as not many white papers can be found on the technology. However, judging from how NPCs work in the Game and how they can be designed to work in the creation kit, it can be deduced that the Radiant AI works based off of multiples rng's which control a multi-tiered behaviour trees to determine what action an NPC would carry out at any given time. Obviously, this would take a very long time and the results would be truly random, so this is therefore limited by the use of some limiting variables such as a certain NPC can only do certain set of things at any given point of time in-game.

As mentioned earlier, Radiant AI, due to its expansive nature can become very unpredictable very quickly. To tackle this, the developers have had to curb it in some ways over the years. This has its benefits in terms of being able to control the flow of the game to an extent that you can tell a good story, but it has also had drawbacks in terms of having most common NPCs being rather too generic and predictable.

This can be noticed the most when having played Skyrim after Oblivion in The Elder Scrolls Series. Oblivion was perhaps the last instalment to have truly Radiant AI.

## **2.5. Creation Engine**

The Creation Engine is a free to use application provided by Bethesda Softworks to allow for the manipulation of existing elements of the game and also to create completely new elements for the game as well. This practice is known as modification or more commonly as mods.

It can be used to create mods for;

1. The Elder Scrolls: Morrowind, Oblivion, Skyrim, Skyrim Special Edition
2. Fallout titles 3, 4

The Creation Kit, gives access to all the assets and files of these games as you load them into the engine and allows you to manipulate these existing assets to create new elements and even add your own assets to create new elements or edit existing elements.

This is a good Application in reference to this research as it provides an alternative where, the research question can be answered within the confines of an existing framework, without having to create a new setting entirely.

The Creation Kit uses Papyrus which was made specifically for the Creation Kit. It can't rightly be called a Programming language, rather a Scripting language. This allows for the writing of new scripts which can then be linked to assets and can be seen working in the game.

## **2.6. Testing the AI**

The application aims to show such behaviour in the AI controlled NPCs which would generally be observed in humans. Considering that the way humans would be expected to react largely varies for any given situation, one could argue that the results would be very subjective.

In light of this, the following possible ways of testing behavioural AI have been considered.

### **2.6.1. Sample Scenario**

One of the ways used to determine if the way AI acts is similar to how humans would in a given situation, can be evaluated using a sample scenario which is then compared to the actions of the AI.

In order to explain how this approach would work, we can take an example scenario where our follower (AI controlled NPC) enters a room and sees someone else present whom they dislike. A human in this scenario would, based on how much they dislike said person, and would:

1. show a change in body language or attitude
2. be visibly annoyed or angry
3. simply leave the venue entirely

The researcher would then have to observe and note down how the follower (AI controlled NPC) acted in this situation and then proceed to compare the results with the human reaction. With this,

the researcher will then be able to create a suggestive conclusion on whether the AI was a success or a failure.

This form of observation can help suggest if the AI shows signs adaptive behaviour. The simplest and foremost way of making these behaviour samples can be based off of the instinctual fight or flight reactions (Kjensmo, 2017). A few aspects relating to the relationship of the follower with the people mentioned in the example can be taken into account as obviously, a human wouldn't generally act out too drastically upon seeing a stranger.

### **2.6.2. Questionnaire (User Testing)**

Another way to evaluate the AI behaviour is through User Testing. Volunteers can be asked to play the game with the follower in question for a given period of time and then fill a questionnaire that outlines questions related to the behaviour of the follower in certain situations that can happen in the game. Questionnaires using the likert scale have been used in many occasions to determine the effectiveness of AI in researches (Futureoflife.org, 2018). A questionnaire adapted from the one mentioned in the future of life survey (Futureoflife.org, 2018) may be used to gather input from users.

The collected information can then be used to statistically evaluate whether the resulting behaviour of the AI was:

1. visible
2. useful

## **2.7. Summary**

The reviewing of previous works has led the researcher to conclude that the best way forward for answering the research question would be to use the game Elder Scrolls V: Skyrim as the premise. The reason for this choice consists of the constraints of time on this research and the existing AI framework of the game itself. The existing AI framework of Skyrim is known as Radiant AI. Radiant AI is an exception piece of Artificial intelligence which is used to handle many dynamic aspects of the game world and is used primarily to manage the daily routines of NPCs and also provide generated quests to populate the world with things to do. An application specifically designed to allow for additions to be made to the game (modding) is called the Creation Kit. The Researcher will make use of the Creation Kit to create a Custom NPC which will act as a follower for the Player and will have a "life" of their own in the routines in place and relationships with some other NPCs in the game world. For the purpose of Answering the Research Question, we will try to create adaptive behaviour in the custom NPC based off of her relationships with other NPCs in the game world. In order to test the application, two separate approaches in testing will be explained.

## 3. Methodology

In order to create the application, it was decided to use a pre-existing framework of AI and premise (videogame) as it would save time and allow for more concentrated work on a particular aspect of AI.

For this purpose, it was decided to use The Elder Scrolls V: Skyrim as the premise. The radiant AI uses an elaborate behaviour tree system as it's framework for the AI present in the game. The application would need to be developed within these constraints.

### 3.1. Introduction

Considering that there is a massive fan base present for this game with the drive to create updated content for one of the bestselling games of all times, Bethesda released an application specifically for the purpose of developing modifications for the game which is better known as just Mods. This application is called the Creation Kit.

The predecessor of the Creation Kit was the Construction kit which was used to create similar modifications for the elder scrolls oblivion and fallout. The success of this application and the sheer consumer demand is what motivated Bethesda to later release the creation kit. the creation kit comes with its own proprietary scripting language known as papyrus.

### 3.2. Decision of Choosing the Approach

While there are benefits to working in a pre-existing environment, like that of Skyrim and using an application specifically designed for editing it, there can be some constricting drawbacks as well.

- **The Benefits:**

A game as critically acclaimed as Skyrim means that if there were any developments made for it, there would be a lot of material online to help with its production. When working on a research in a small time window, the researcher must look at ways to avoid extra work and try to allocate as much time as possible to the important parts. In light of this, Skyrim made for a good choice as it came set up with a premise, AI Framework and a means to manipulate it enough to create the elements desired.

- **The Drawbacks:**

One of the major drawbacks of this approach is the limitations one can face in solving a problem. Some problems, which can be resolved through an algorithm easily built in C++ may not be your first choice when trying to do the same thing in the papyrus scripting language. This pushes the researcher to find other ways of resolving the problem which can be tedious and result in slower progress.

After careful, deliberations, it was decided that the benefits of working in the Creation Kit outweighed the drawbacks.

### 3.3. Implementation

To set up the mod for this research, we first created our custom NPC in the creation kit. all modifications are saved as a plugin which is installed on top of the vanilla game. Although the modifications are made while using the master files, any changes made to them are saved in the mod plugin so that the original game is never effected.

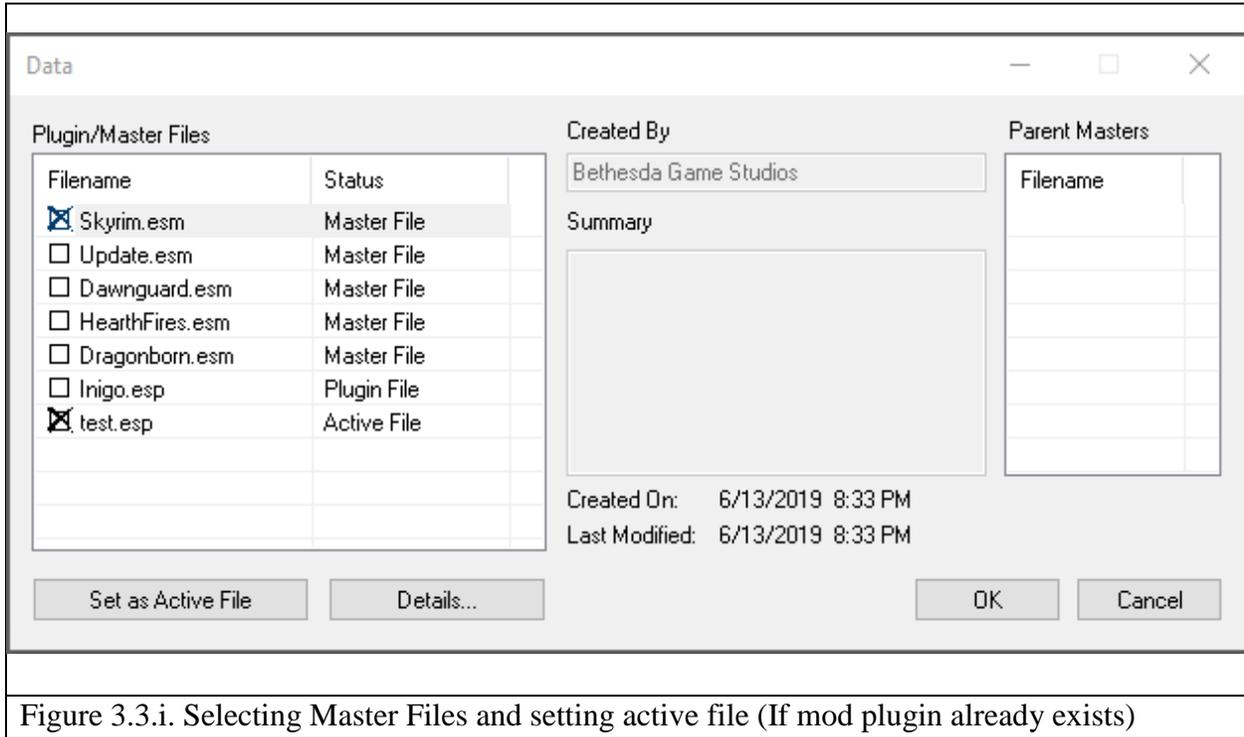


Figure 3.3.i. Selecting Master Files and setting active file (If mod plugin already exists)

### 3.3.1. Setting up the NPC

Once all the master files have been loaded, open the Actors tab in the object window in the Creation kit.

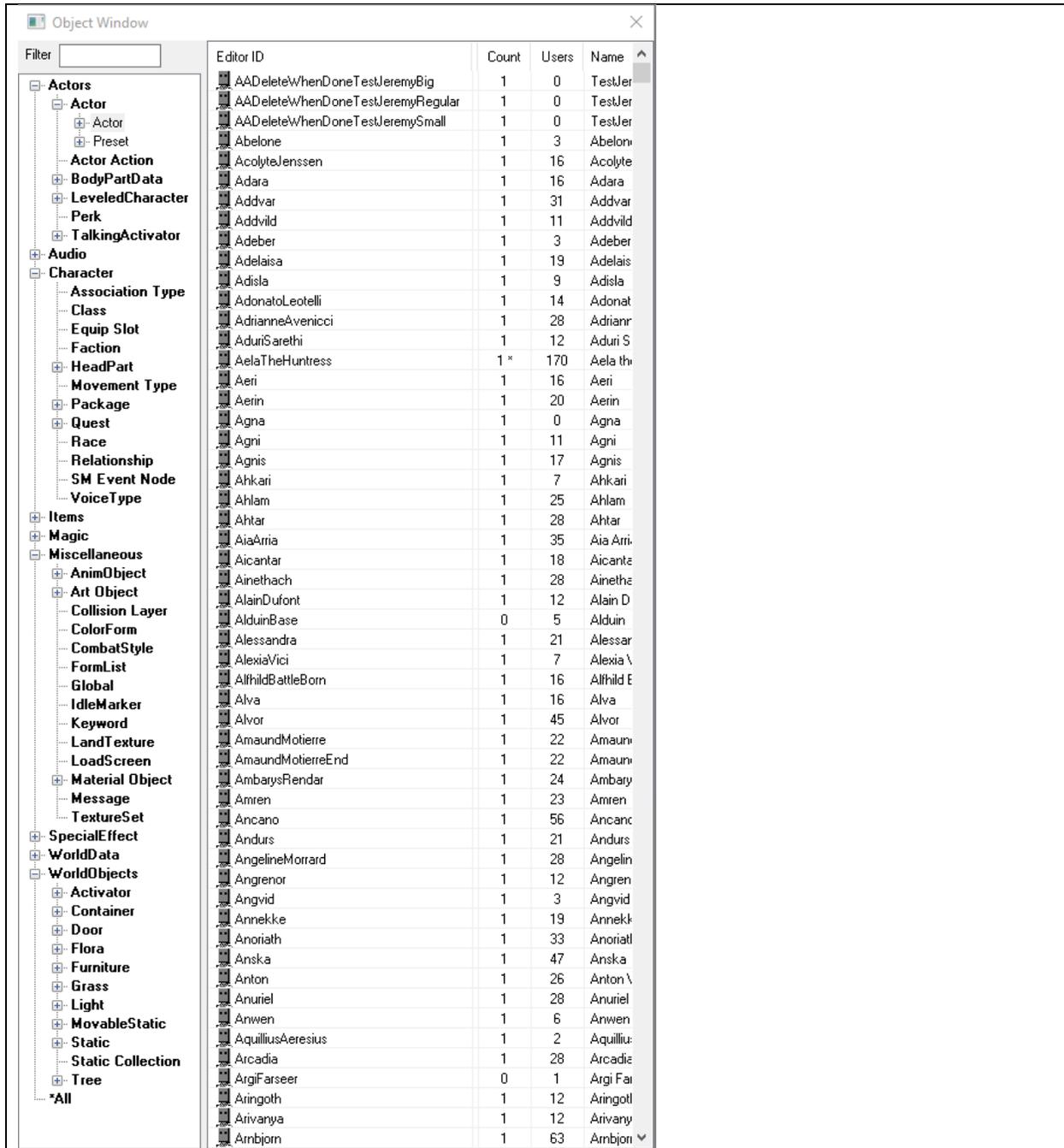


Figure 3.3.1.i. Object Window in Creation Kit

In this list, on the right side is the list of all NPCs, beasts and people in the game. Right click on an of them and select new to open the actor creation window.

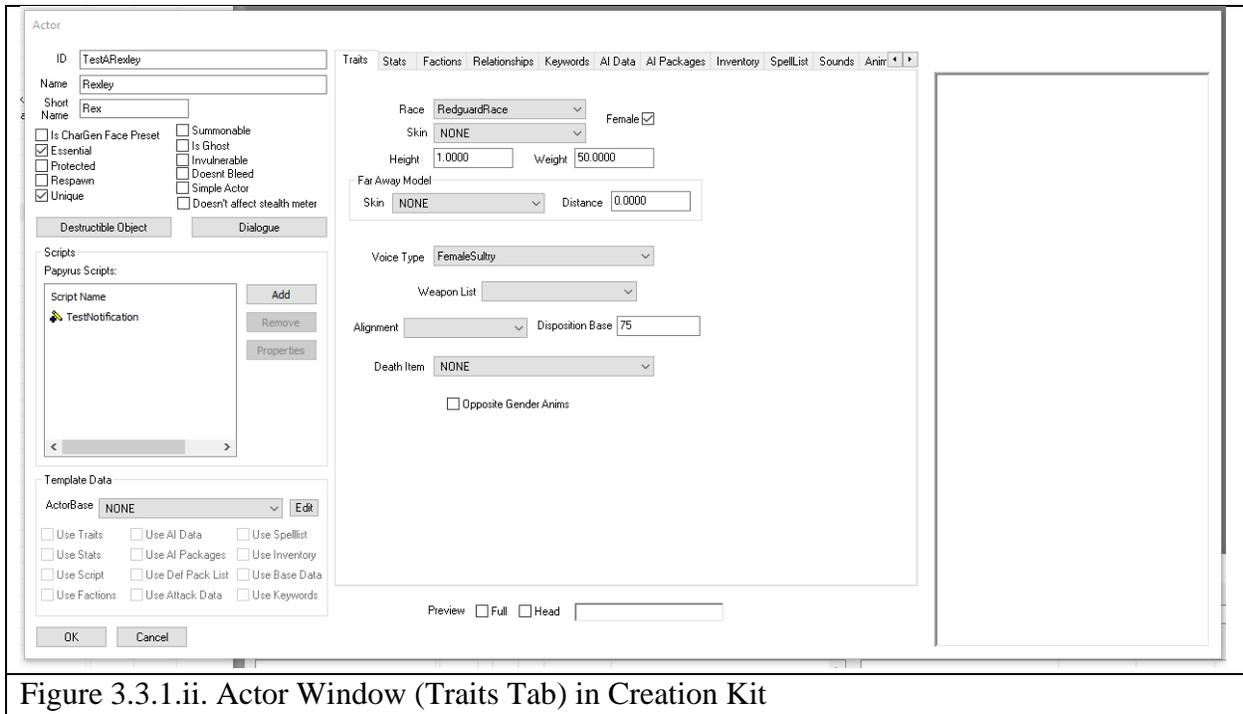


Figure 3.3.1.ii. Actor Window (Traits Tab) in Creation Kit

In the left pane of the Actor Window, there is the identification information of the custom NPC.

1. ID: this is the unique Editor ID of the NPC that it will be found by in the creation kit editor.
2. Name: is the Name of the Actor
3. Short Name: is a short name that can be given to the NPC for radiant quest purposes.
4. Checkboxes: the list of checkboxes are unique properties which can be given to the NPC such as Essential which would render the NPC un-killable and Unique which means that there can only be one such NPC with no duplicates.
5. Papyrus Scripts: this is the tab where scripts written up, can be attached to the NPC so that they run once the NPC is loaded into the game.
6. Template Data: a new NPC can use the information of another pre-existing NPC's their Base. The checkboxes are the tabs which will be filled in with the information of the template NPC.

In the right pane of the Actor Window, there are a number of different tabs which each control different aspects of the actor.

1. Traits Tab: This tab allows the set up the Race of the follower, their Skin, weight and height can also be set here. The sex and voice type of the NPC is also determined in this tab.
2. Inventory Tab: This tab allows the setup of the default attire the NPC will be wearing at all times and a sleep outfit (if different from normal outfit). Items to their inventory can also be added here that would be expected to have on them.
3. Character Gen Parts: this tab allows the setup of the specific skin color of the NPC and any other specific tweaks to the actual appearance of the NPC such as their eye shape, makeup, war paint, jaw, nose etc.



### 3.3.3. Setting up the Daily Routine

In order to blend the NPC into the game world, routines can be appointed to them. These routines are called AI packages and they have a separate tab for themselves.

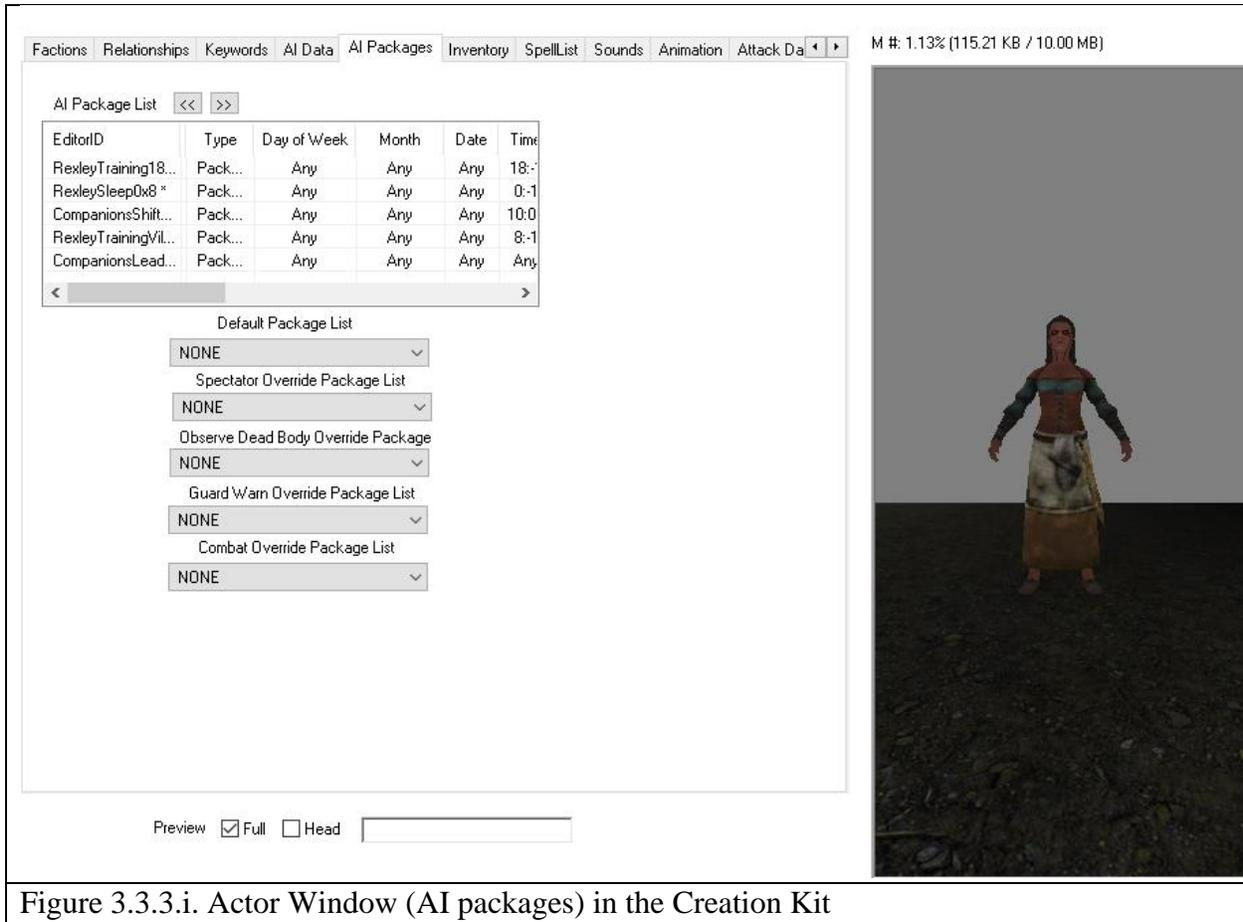
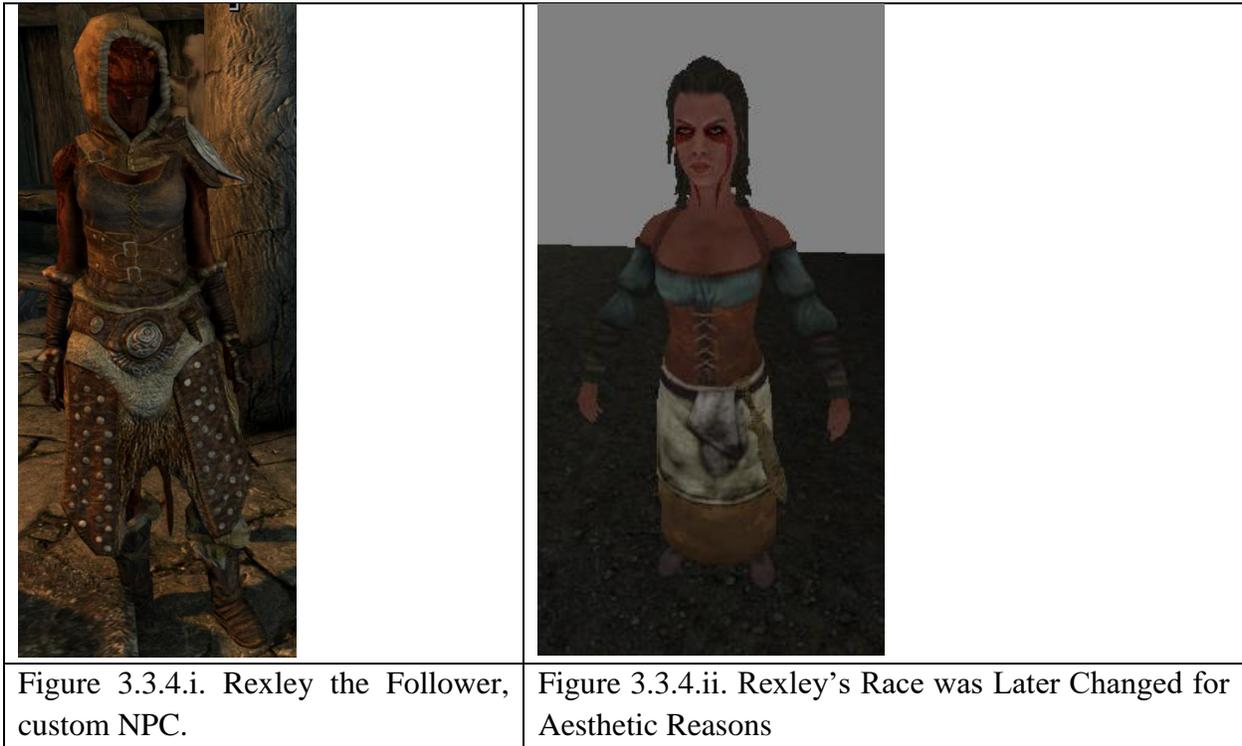


Figure 3.3.3.i. Actor Window (AI packages) in the Creation Kit

AI packages elaborate behaviour trees which are used by the AI framework present in Skyrim to determine what each NPC in the game world should do at any given point in time. The custom follower was also given such a routine which ensures that she has something to do to go about her day.

### 3.3.4. Appearance of Follower



The custom follower can be found doing random things in Jorvaskarr, the great mead hall of the companions' in White run.

At this point of the development of the follower is where we go a step further from the Base Game (vanilla) followers. While vanilla followers have something to do in their lives when they aren't on an adventure with the player, they don't really have any particular affiliations with the people around and don't appear to get affected by what happens around them.

In order to answer the research question, the researcher observed that, all the tools required to show somewhat reactionary or adaptive behaviour in NPCs is all present in the creation kit but never implemented.



### 3.3.6. Expression of Reactionary/adaptive behaviour

Based on the different relationship levels with these characters, a separate personality was created for each. It was then deduced that the best way to show this change or reaction would be through some form of interaction. The most natural way of doing this would be to have the follower choose to initiate conversation with any of the above people and based on what they would say to her, have her personality be set to that one as a reaction.

This would be more than a simple change in mood to show a greater amount of repercussions or consequences. Depending on whom the follower spoke too, they would prefer a different style of combat and possibly affect their aggression or confidence level. It could also possibly effect their level of freely giving assistance to those around them.

The 4 different personalities created had their own unique appearance to make the shift abundantly clear to the player and also quite a few intrinsic changes which would be visible under specific situations.

- **Personality 1: Neutral**

This is the reaction associated with the presence of the NPC known as Skjor. Skjor and the custom follower, Rexley have a Boss/Employee Relationship whereby, Rexley looks up to Skjor as a respected mentor. Considering that, it would make sense that Rexley would remain calm, composed and reserved in his presence. Due to this:

- a. Rexley initiates combat with enemies
- b. Rexley helps friends and neutrals around her
- c. Rexley doesn't fear an opponent if they are stronger than her
- d. Rexley has neutral expressions

Rexley dresses in her normal day to day attire and chooses to opt melee warrior combat style which is the use of a sword in short range.

- **Personality 2: Happy**

This reaction is associated with the presence of the NPC known as Aela the Huntress. Rexley and Aela have a spousal relationship. This means that it would be appropriate or fathomable to show a change in behaviour to a happy and lively outlook in Rexley when Aela is around. Due to this:

- a. Rexley initiates combat with enemies
- b. Rexley helps friends and neutral around her
- c. Rexley is cautious of her opponent
- d. Rexley has a happy expression

Rexley changes her attire to something more "homely" and prefers ranged combat with a bow, quite like her spouse.

- **Personality 3: Sad**

This reaction is associated with the presence of the NPC known as Vilkas. Rexley and Vilkas have a few grievances for the purpose of showing a different array of reactions on Rexley's account. Due to this we are able to deduce that under such circumstances:

- a. Rexley does not initiate combat
- b. Rexley doesn't help anyone
- c. Rexley becomes somewhat cowardly and runs from combat
- d. Rexley has sad expressions

Another element to this personality is that it visibly upsets Rexley's routine. One could argue that when depressed, people like to retire to their rooms and prefer being alone, likewise Rexley prefers to drop everything and simply to go to bed. Apart from this, she changes into dark robes.

- **Personality 4: Angry**

This is the last of all the possible personality changes seen in Rexley and this one is associated with the NPC known as Farkas. Farkas is the Twin Brother of the NPC Vilkas, mentioned earlier. Keeping with the theme of the relationships with the twins, Rexley has some serious differences with Farkas. Due to this:

- a. Rexley initiates combat with enemies
- b. Rexley doesn't help anybody
- c. Rexley doesn't fear if the opponent is stronger than her
- d. Rexley has an angry expression

Similar to Vilkas, Rexley has a noticeable change in her routine in reaction to Farkas as well. In this case Rexley gets extremely angry and decides to drop everything and resort to violence. In light of this, Rexley goes out to the training yard and spends the rest of her day away rigorously training to blow off some steam. In this change, Rexley dons some heavy and large armour and also prefers a brutish approach to combat.

### 3.3.7. Papyrus Scripting

In order to actually have the personalities mentioned above set into place, we need to write up a script. The way papyrus scripts work is based off of Events fired from within the game at certain junctions. One of these said junctions is an even known as the OnGainLOS event.

- OnGainLOS Event

The OnGainLOS event is sent when a set target is in line of sight of a set viewer. When this event is sent, any scripts holding this event will then be run. In order to get this event to send a flag to our script, we will first need to register our script to receive these flags. This can be done on an event known as the OnInit Event.

- OnInit Event

The OnInit Event runs once on startup of the game. For the OnGainLOS as mentioned earlier, there is a target and a viewer. These are set and register for the event in pairs, therefore for the purpose of our mod, we register for four possible events which encapsulate scenarios where an event may be fired when Skjor, Aela, Vilkas or Farkas are in the line of sight of Rexley.

Once this is done, we simply check who the target found was, and set their corresponding effect. While simple and effective, it doesn't make for the best results as all 5 people are in the same room for the better half of their day and it just doesn't seem natural to have Rexley constantly change her mood. For this reason, an addition was made that whomever Rexley sees the most out of the four, that personality will be set instead. In order to allow for a nice variety of changes, the personality will be reset to neutral after Rexley goes to bed (sleep).

The initial plan was to have Rexley's AI packages' RNG choose and initiate conversation with the four NPCs and have these personalities set as a result of these conversations. However, unfortunately, this proved to be quite time consuming, convoluted and difficult to implement, especially when reusing existing dialogues instead of creating entirely new ones. This issue is discussed in detail in the future work section as despite issues faced at current time forcing this approach to be dropped, it nonetheless will be pursued in future work to ultimately implement at some point in time.

This method also works and provides the same ultimate result as the point of having line of sight or conversations is some form of interaction to show that the follower is aware of their presence and that it affects her in different ways. Therefore, one could then say that the follower, adapts her behaviour based on whose presence out of the four NPCs is most dominant.

### **3.4. Summary**

The application was made as a Plugin or Add-on which means that it is not standalone, and requires installation on top of its parent application to work. The parent application for this is a videogame called The Elder Scrolls V: Skyrim. The plugins or add-ons created to work with Skyrim are called Mods. Mods for Skyrim can be created in an application known as the Creation Kit. The Creation Kit uses all the assets available in Skyrim and its DLCs as master files to allow the creation of Mods. NPCs are only one of the many things possible to create for Skyrim. The Graphical User Interface allows going through the process of creating the look, skills and routines of the NPC. NPCs can also be added into specific factions to allow them to interact with the player in a different way. Like so, an NPC was created and added to the follower faction. Scripts can also be added, either as fragments on top of existing scripts through the Creation kit, or entirely new scripts, written in an external editor. One such script was written and added onto the NPC. This script is the main instrument which holds the algorithm to allow showing adaptive behaviour in the NPC.

## 4. Evaluation

### 4.1. Choosing the Testing Method

Since the fact that adaptive behaviour can be seen or not is so subjective, the best way to observe it would be through user testing. 12 people who were known gamers, casual or otherwise were asked to play the Elder Scrolls V: Skyrim with the mod installed for at least 30 minutes. They were then asked to record what they observed by way of a questionnaire. The questionnaire was made with the answers being measured on a Likert scale.

The results provided with the instrument were first run through a reliability test to see if the instrument could be used for further evaluation:

<b>Scale: ALL VARIABLES</b>				<b>Scale: Excluding Q2</b>			
<b>Case Processing Summary</b>				<b>Case Processing Summary</b>			
		N	%			N	%
Cases	Valid	12	100.0	Cases	Valid	12	100.0
	Excluded <sup>a</sup>	0	.0		Excluded <sup>a</sup>	0	.0
	Total	12	100.0		Total	12	100.0
a. Listwise deletion based on all variables in the procedure.				a. Listwise deletion based on all variables in the procedure.			
<b>Reliability Statistics</b>				<b>Reliability Statistics</b>			
Cronbach's				Cronbach's			
Alpha		N of Items		Alpha		N of Items	
.764		12		.776		11	
The Cronbach's Alpha is .764 which is > .5 significance value which means that the results of all the questions in the instrument are reliable.				The results were also checked for reliability excluding one of the questions in order to see if they held merit without it. The Cronbach's Alpha is .776 which is > .5 significance value which means that the results did indeed held merit and were reliable on their own as well.			

The Instrument is attached in the appendix.

## 4.2. Evaluation of Tests

The answers provided by the testers were between 1 and 5 where 1 being the lowest and 5 being the highest. The results for each question were then evaluated collectively and separately in order to carry out some descriptive statistics based off of our hypothesis.

<b>Descriptive Statistics</b>					
	N	Minimum	Maximum	Mean	Std. Deviation
Duration of the playthrough	12	1.00	5.00	2.8333	1.19342
Easy to Find Follower?	12	1.00	2.00	1.0833	.28868
Variability of behavior compared to vanilla	12	3.00	5.00	4.3333	.77850
Did you notice a change in routine?	12	3.00	5.00	4.0833	.66856
Change in Combat Style	12	3.00	5.00	4.3333	.65134
Confidence level when confronting enemies	12	3.00	5.00	4.0833	.79296
Change in appearance	12	2.00	5.00	4.2500	1.13818
Awareness of Sorroundings	12	2.00	5.00	3.5833	.90034
Humanly reaction of the follower	12	2.00	5.00	3.5833	.99620
Benefit of similar effect on other followers	12	3.00	5.00	4.3333	.65134
Behaviour in terms of adaptability to the situation	12	2.00	5.00	3.9167	.99620
Recommendation to others	12	3.00	5.00	4.5000	.67420
Valid N (listwise)	12				

Table 4.2.i. Basic Statistics of all the results of the instrument

The information provided in the table above shows that the overall feedback was positive on the mod. The second question, “easy to find follower?” only has two options where 1 is yes and 2 is no which is why the mean is 1.08 but still considered good as this means that the contents of the mod were easy to find in-game. The other two dips can be seen in the variables “Awareness of Surroundings” and “Humanly reaction of the follower” where the means are 3.5833. this value means that most testers stood in the middle of the Likert scale skewing more towards the higher score. This can be translated as the testers observed that the follower did show signs of awareness and humanly reactions but not to a degree that they would’ve liked.

For the researcher, this is a positive sign as currently, the mod only takes into account the presence of 4 NPCs and consequent reactions. Should the Mod be expanded in the future with the number of NPCs being taken into consideration also going higher, would certainly make the effects of these two variables more overt.

The following graph shows where the average answers landed on the Likert scale in relation to the duration of the play through (Q1) and whether the follower was easy to find (Q2).

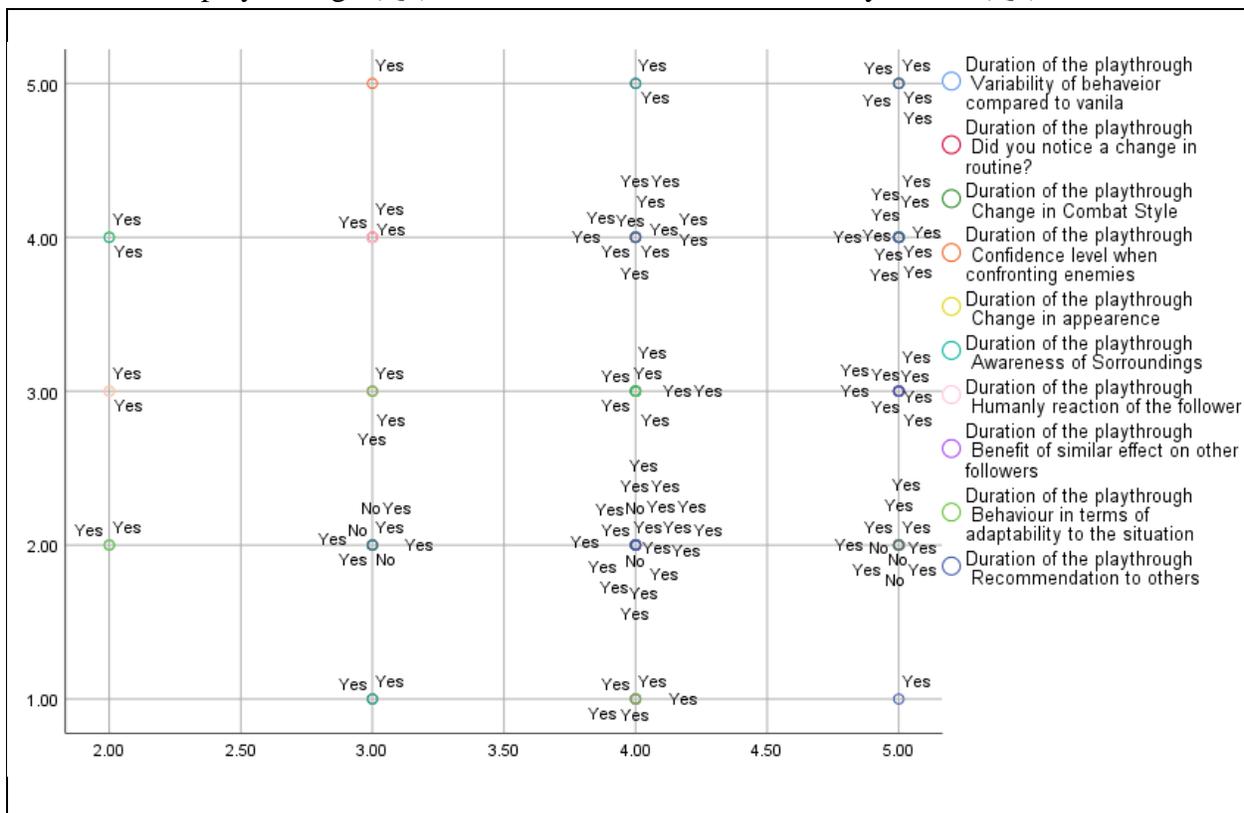


Figure 4.2.i. Graph depicting where most answers lie on the Likert Scale in Relation to the First 2 variables of the instrument.

Most of the variables can be seen co-dependent on the first two variables, as one could argue that the first variable, “duration of the play through” could heavily effect how other variables may be answered. The same can be said for the second variable as these two directly question how long the testers were in interaction with the mod.

Due to this, the graph above explores how that has had an effect on the other answers. One notable thing that can be evaluated from the graph is that, it would be fair to assume that the longer the testers played with the mod, the more likely it was for them to not only find the follower, but also observe noticeable elements of adaptive behaviour. The larger portion of testers sit on 4 (Mostly Yes) of the Likert Scale, which is a good sign for the Mod’s Success.

The variables were also observed individually to see where most testers stood on the Likert scale.

### 4.2.1. Question 1

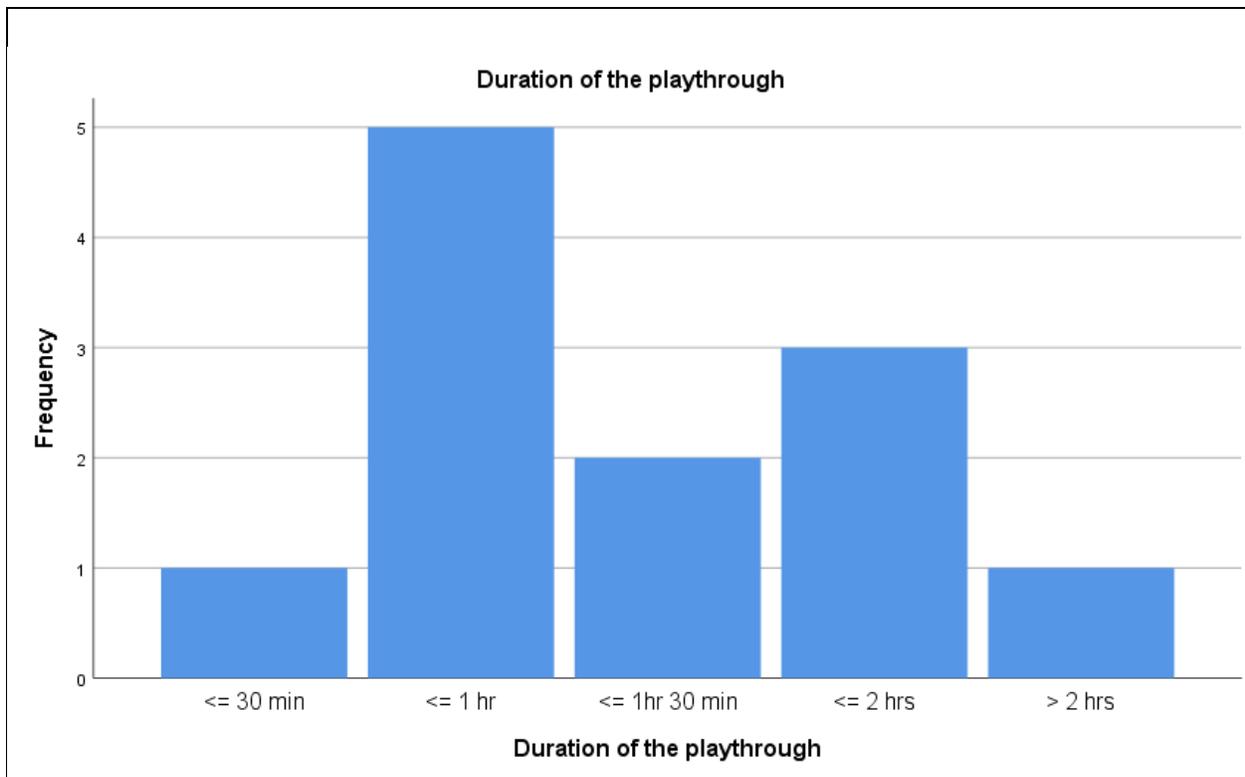


Figure 4.2.ii. Graph showing the frequency of answers for the first variable, “Duration of Playthrough”

This graph shows how long the testers played the mod and it would appear that the majority played in the “<= 1 hr” window.

### 4.2.2. Question 2

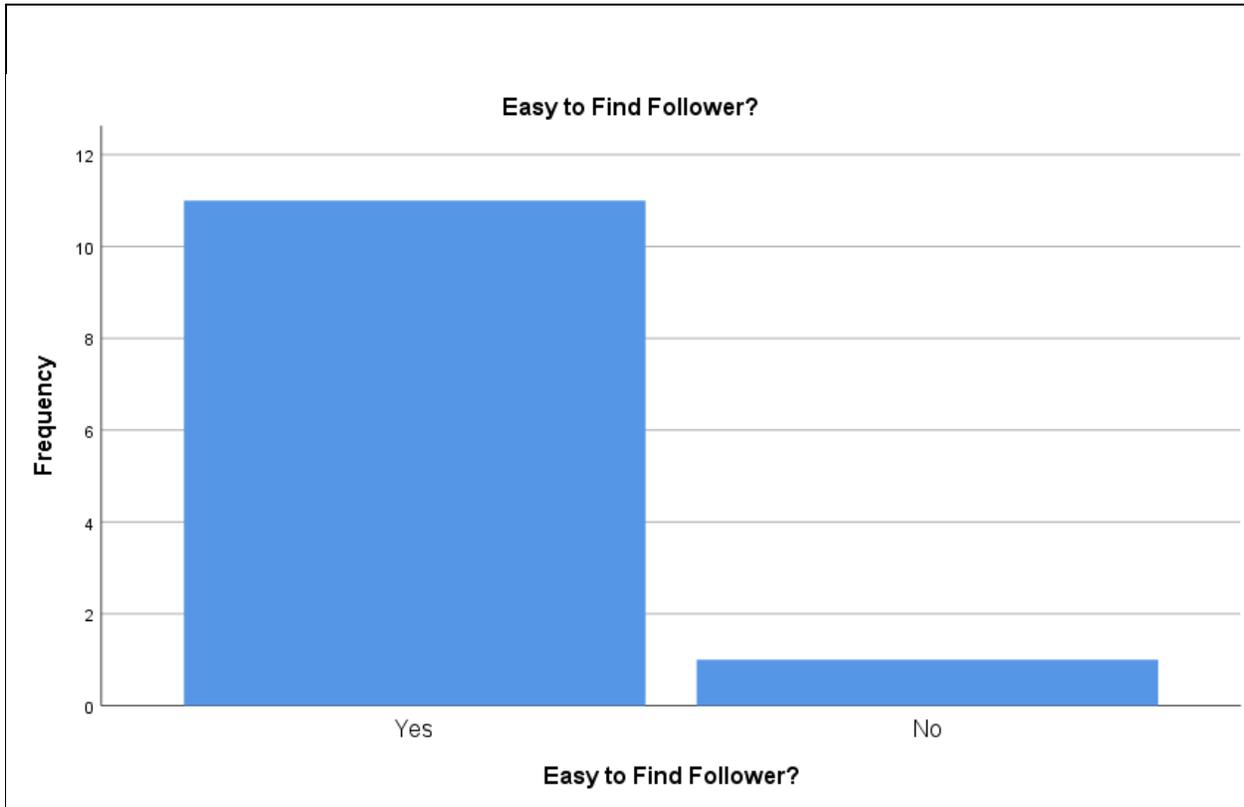
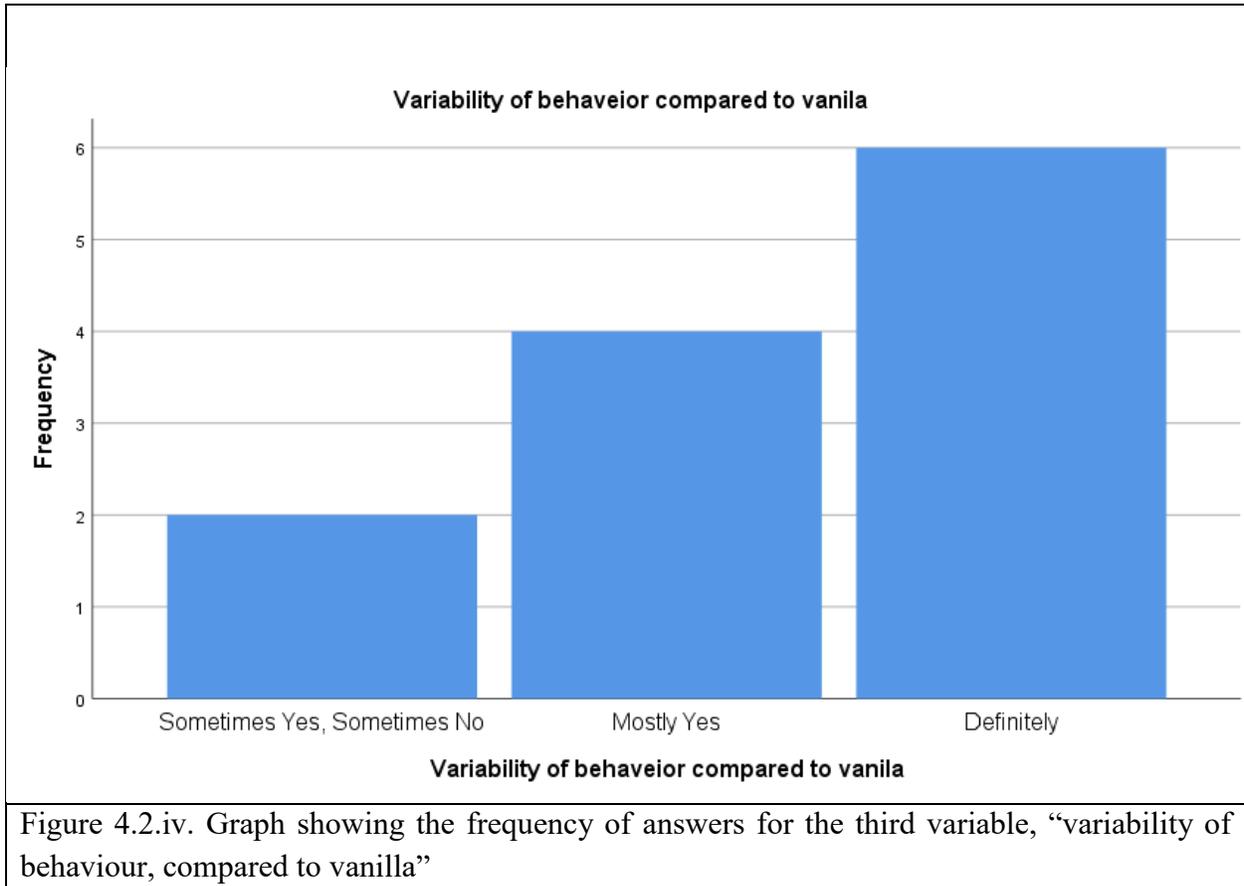


Figure 4.2.iii. Graph showing the frequency of answers for the second variable, “Easy to find Follower”

This graph shows how many testers were able to find the follower easily enough to begin the main part of the testing process. This variable was initially put in the instrument to catch bugs and also evaluate if a future plot idea was explored, would it be reasonable to continue building it upon the current premise or change it entirely.

It would appear that most people found the follower without any issues, except 1 tester, this was due to a bug encountered on his end. This is further discussed in one of the later variables and future work.

### 4.2.3. Question 3



The Mod was in some ways compared to what the base game had to offer for two reasons.

1. Was there a noticeable difference in behaviour?
2. Is this something the players of Skyrim be interested in?

Judging from the results illustrated in the graph, all answers were positive feedback with the majority in the 5 or “Definitely” bracket of the Likert scale.

#### 4.2.4. Question 4

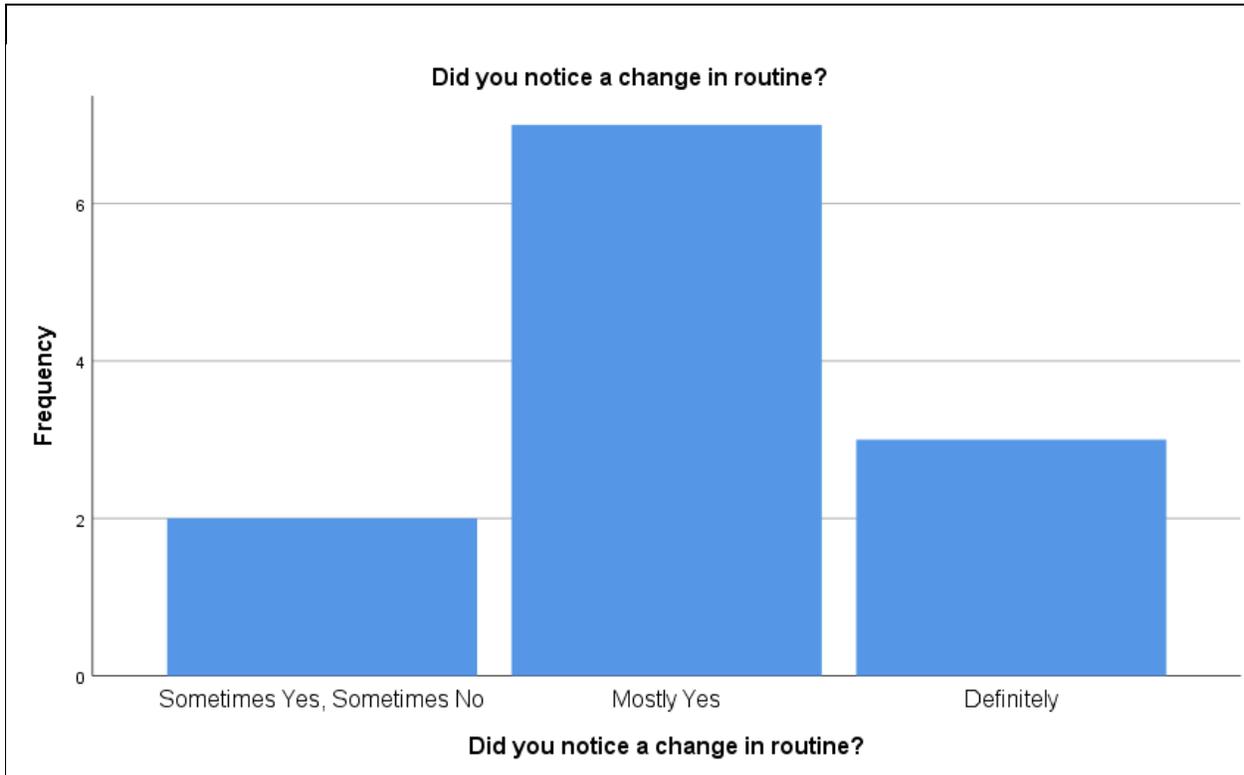


Figure 4.2.v. Graph showing the frequency of answers for the fourth variable, “Did you notice a change in routine?”

One of the key elements of the Mod was to show that it was possible for NPCs to change their daily routines in reaction to something or someone. The graph above shows that all testers certainly saw some change in routine while most of them remained in the 4 or “Mostly Yes” section of the Likert scale.

### 4.2.5. Question 5

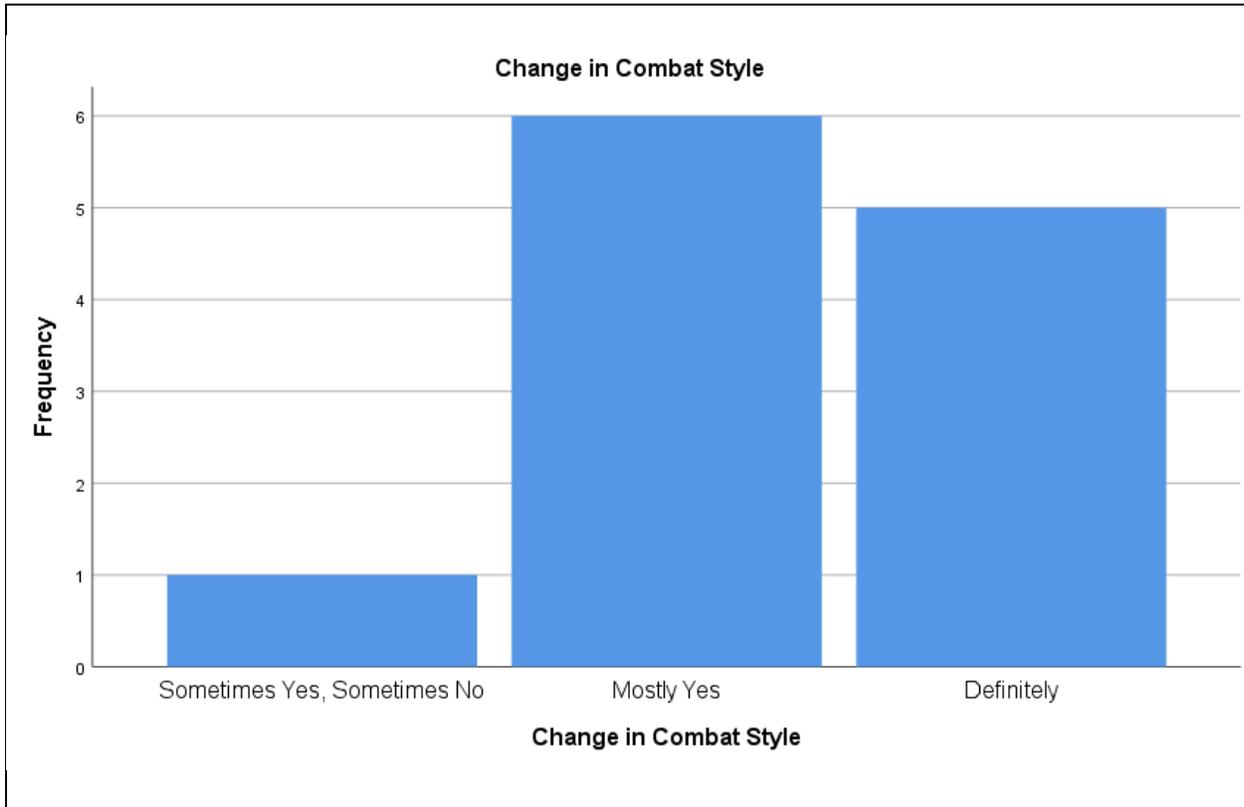


Figure 4.2.vi. Graph showing the frequency of answers for the fifth variable, “Change in Combat Style”

A part of shifting the NPCs behaviour was also changing their preferences in certain things such as combat style. Each personality was given a different combat style which was best suited to it. The graph above shows that the testers did notice a change in combat style and most remained firmly in the 4 or “Mostly Yes” section of the Likert scale.

### 4.2.6. Question 6

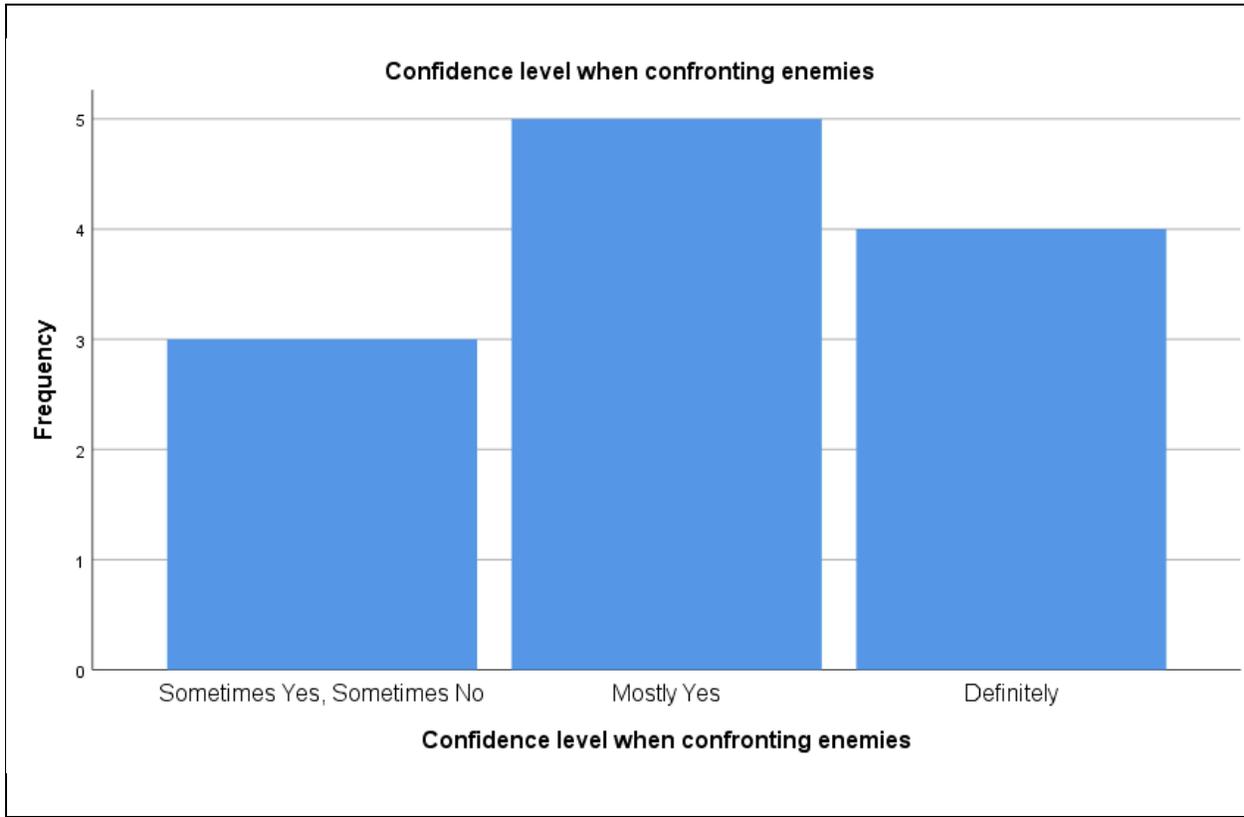


Figure 4.2.vii. Graph showing the frequency of answers for the sixth variable, “Confidence level when confronting enemies”

There is a trait in each NPC known as the confidence level, which primarily controls how NPCs are expected to react in the face of danger. Some NPCs might be brave or foolhardy and jump at a confrontation, while others may be cautious or even cowardly that they may flee. Similar to combat styles, each personality also had a distinct confidence level.

The graph shows that all testers did notice a shift in confidence in the Mod’s follower as well with the majority being in the 4 or “Mostly Yes” region.

### 4.2.7. Question 7

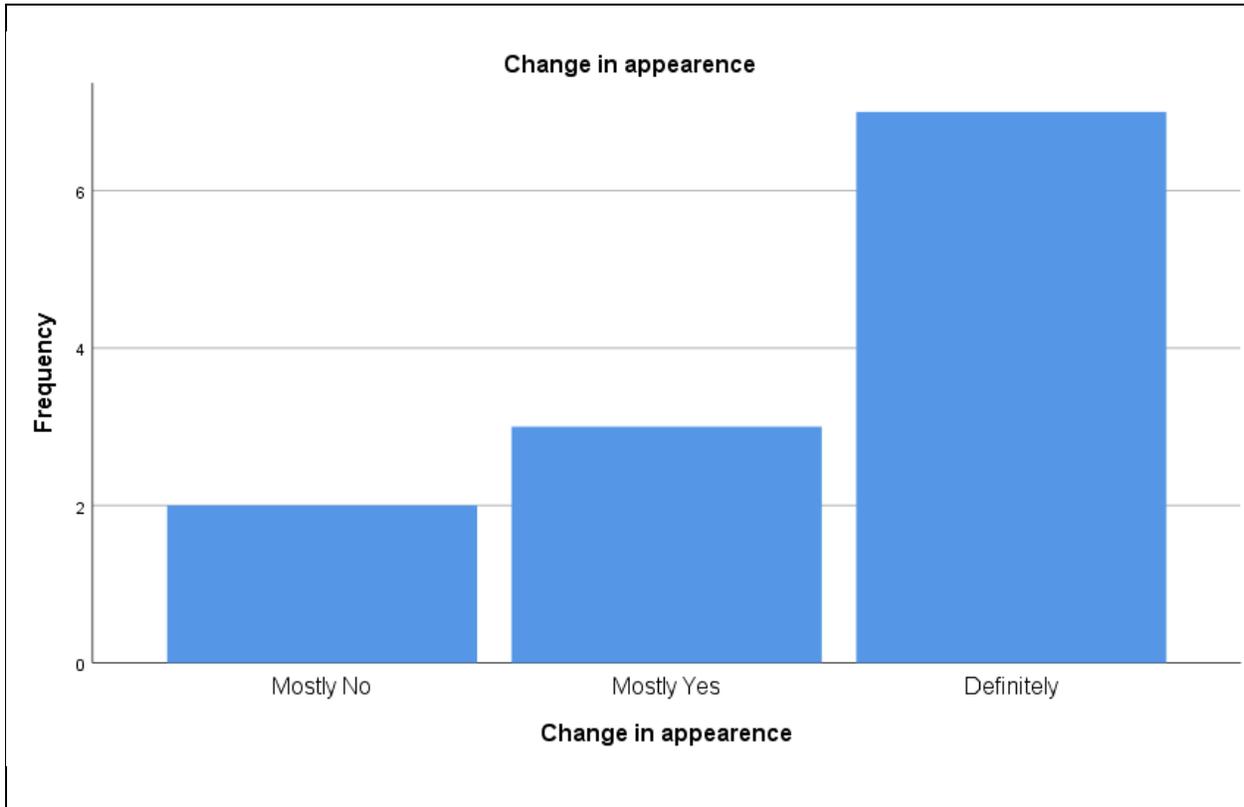


Figure 4.2.viii. Graph showing the frequency of answers for the seventh variable, “Change in appearance”

It is understandable that most elements of the personalities are not instantly noticeable or explicit. For instance, a change in combat style or confidence would only be noticeable in combat. So in order to make the changes in behaviour or the shift in personalities more noticeable, the Mod’s follower’s outfit would also change.

It would appear as this successful as the results illustrated in the graph show that majority of the testers “Definitely” noticed this change.

### 4.2.8. Question 8

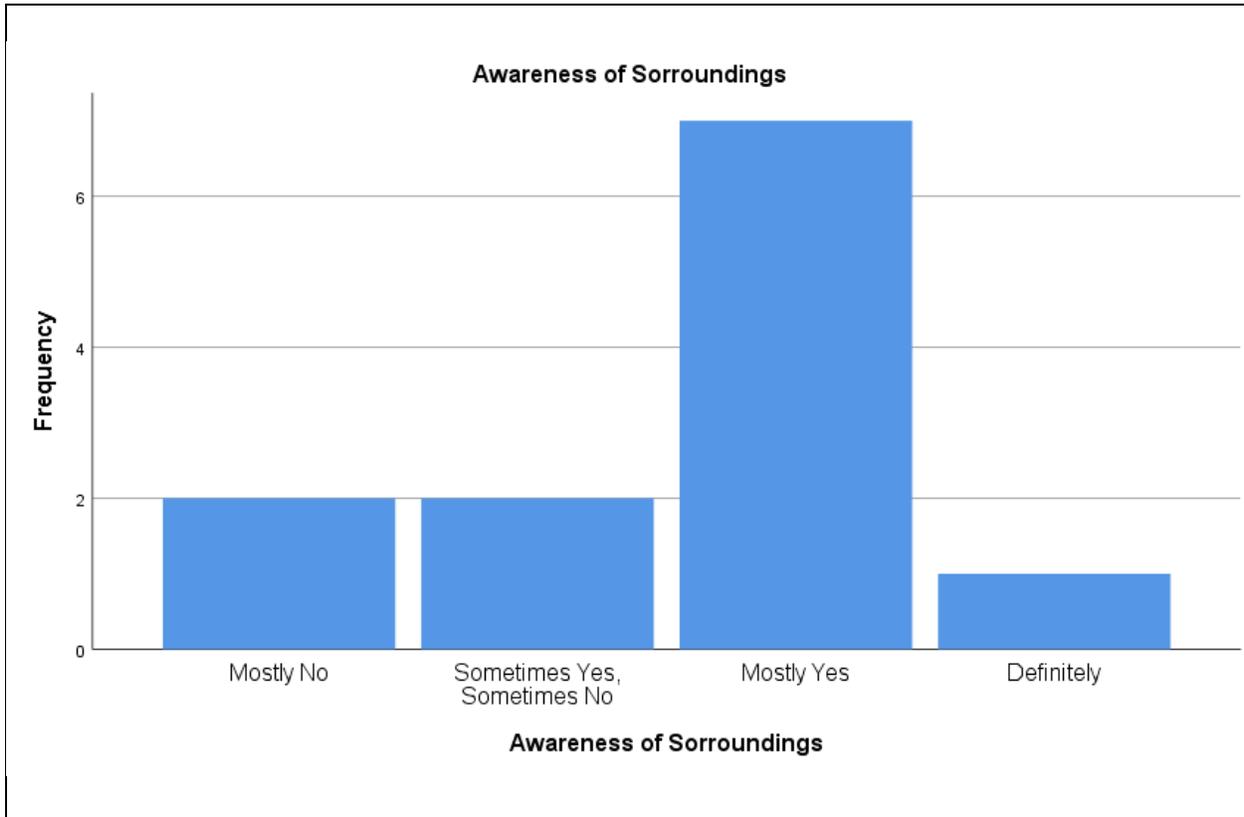


Figure 4.2.ix. Graph showing the frequency of answers for the eight variable, “Awareness of Surroundings”

A change in behaviour is one thing, but noticing what caused this change is another. The graph above illustrates the results of a question relating to the awareness of the Mod’s Follower. Showing signs of being aware of one’s surroundings adds to the effect that changing personalities has. It is paramount to show that the follower isn’t changing its mood out of the blue, rather something in its surroundings is what’s causing it.

The results of the graph appear to indicate that most testers believe that it was with “Mostly Yes” having the highest frequency, however there were a few who didn’t notice such awareness as well with “Mostly No” having a frequency of 2.

### 4.2.9. Question 9

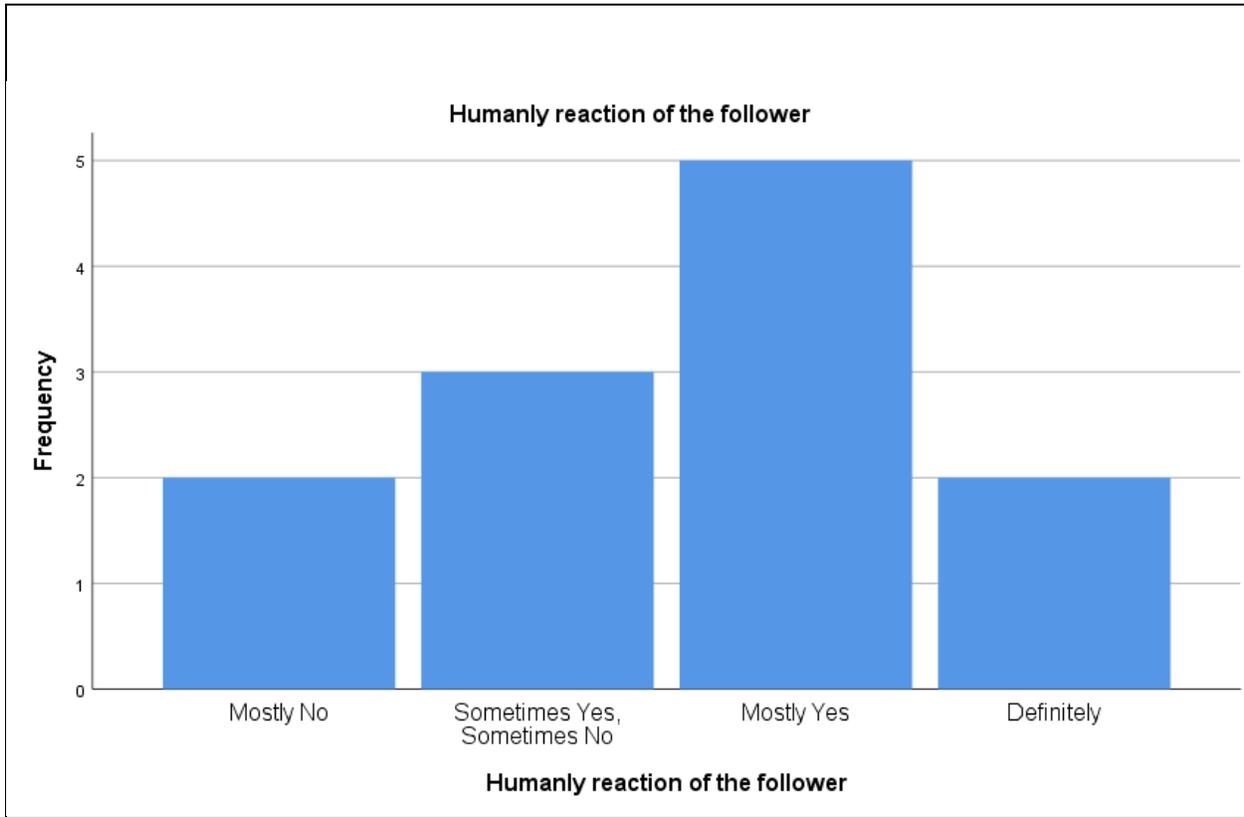


Figure 4.2.x. Graph showing the frequency of answers for the ninth variable, “Humanly reaction of the follower”

The last aspect of creating a dynamic follower in videogame is to make sure that their actions or habits are human enough. As the NPCs would look very out of place if they didn’t act human in a world which is supposed to mimic human settlements.

This graph shows that most testers agreed that the Mod’s Follower appeared to have humanly reactions and actions.

### 4.2.10. Question 10

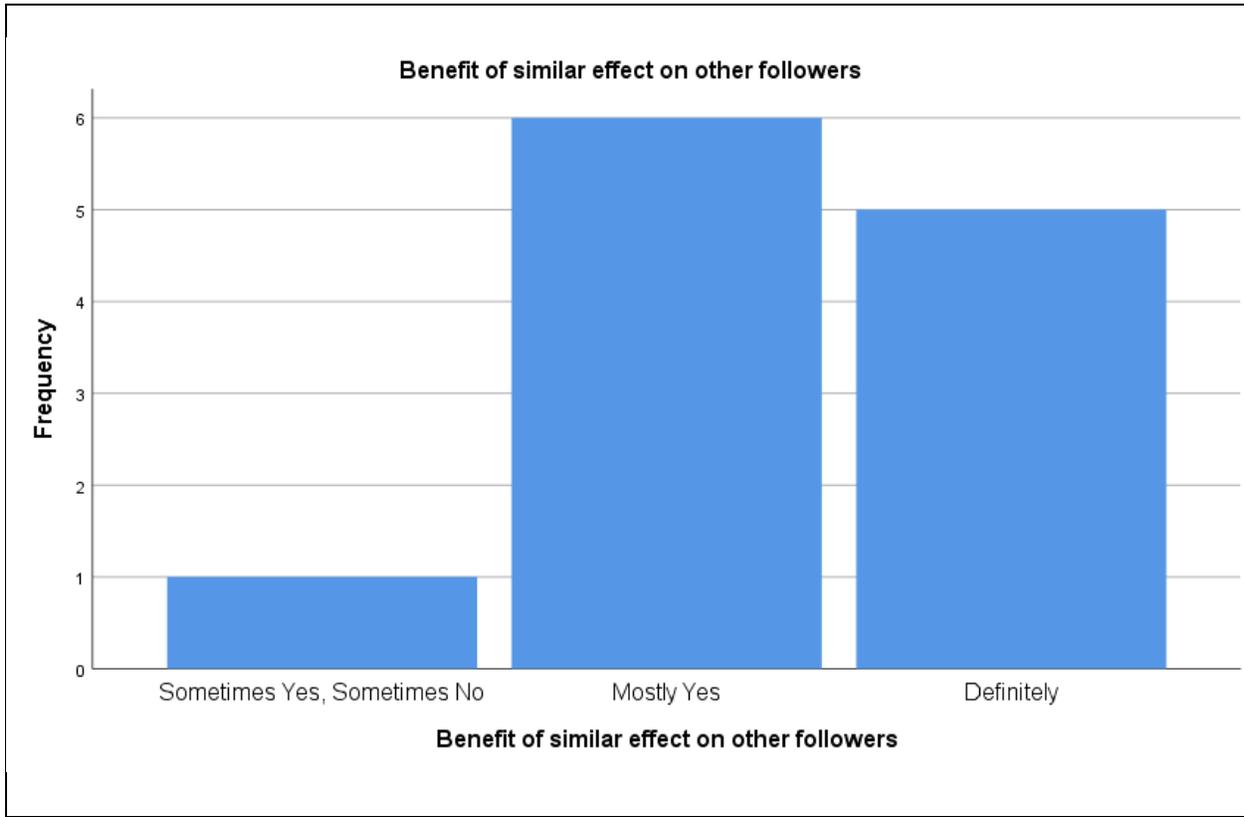


Figure 4.2.xi. Graph showing the frequency of answers for the tenth variable, “Benefit of similar effect on other followers”

The graph above shows the results of the testers when asked if they would like to see similar behaviours on followers available in the base game. Most of them answered with “Mostly Yes”. This is very good feedback as this means that the Mod’s follower performed so well in some tester’s opinion that they would like to see other NPCs in the world behave in a similar manner.

### 4.2.11. Question 11

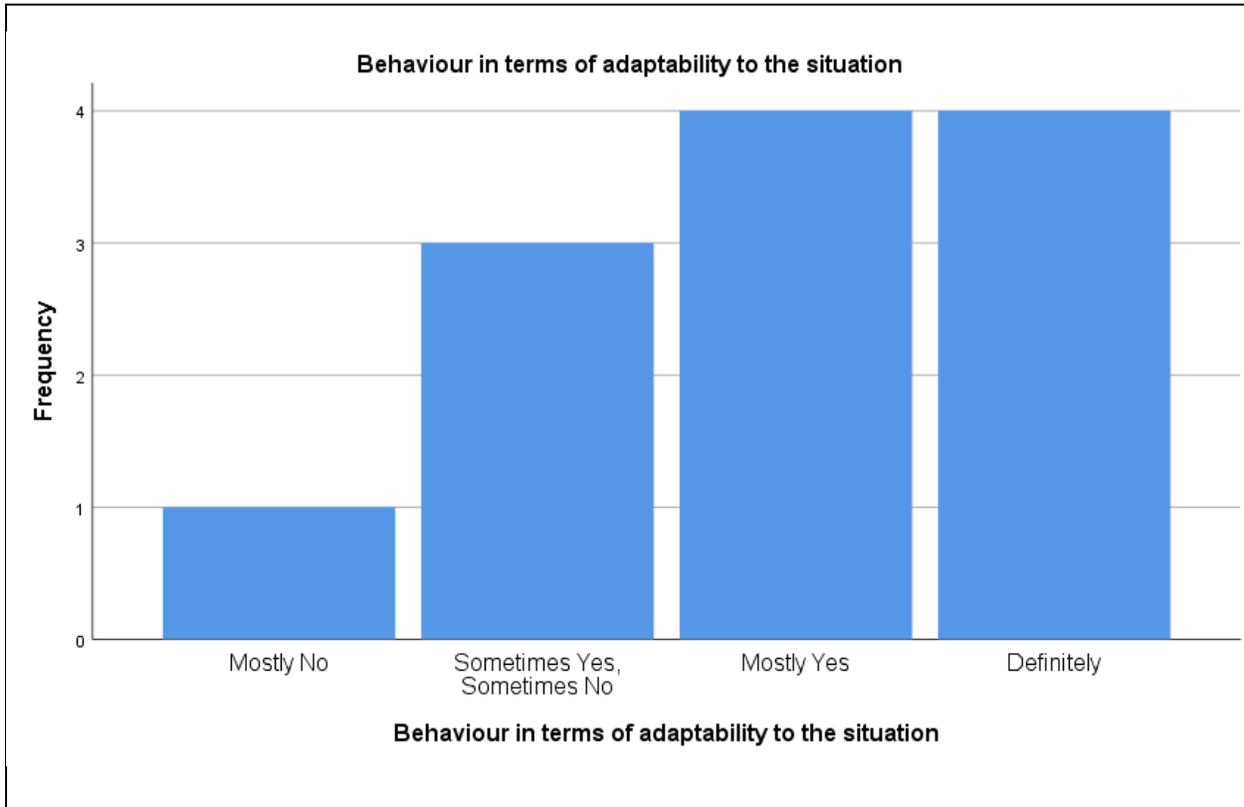


Figure 4.2.xii. Graph showing the frequency of answers for the eleventh variable, “Behaviour in terms of adaptability to the situation”

Each personality had its own unique actor values such as confidence levels and combat styles, however this was not enough, it was also important to make sure that when personalities shifted, they made sense in terms of because of whom. The testers were asked, based on whom the follower looked at the most, did it make sense for her to react the way she did? In other words, did she adapt appropriately to the situation.

The graph illustrates what the testers thought about this which is a resounding yes.

### 4.2.12. Question 12

<b>WHAT ADAPTIVE BEHAVIORS COME TO YOUR MIND THAT YOU FOUND LACKING IN THE FOLLOWER?</b>	
<b>1.</b>	Nothing was lacking as such, rather the shifts in behaviors were too dramatic or exaggerated to feel natural... the follower will benefit from a change in behavior over time.
<b>2.</b>	The behaviour was not lacking, However, it would make for a smoother transition if the intensity of the behaviour was increased gradually over time. rather than all at once at the specified intervals
<b>3.</b>	it disappears few times when she goes out of the jorvaskr cabin
<b>4.</b>	she got glitched at some point of the game that we had to attempt killing her, which has actually fixed the glitch after trying few different solutions
<b>5.</b>	The follower is supposed to react to the people around her
<b>6.</b>	Not really, it's good as it is
<b>7.</b>	i think her reactions should be more OBVIOUS so that it gives more humanish effect, rest it's all good
<b>8.</b>	A little bit of erratic behavior (wanting to do something of her own or saying she wants to, giving suggestions etc.) would be pretty cool.
<b>9.</b>	Getting sick from an extreme change in temperature in the environment.
<b>10.</b>	The Personality seems too dependent on the Companions. While she does adopt the Look and Combat Style, it Would appreciated if she also adopted their gimmick like how Farkas is afraid of Spiders
<b>11.</b>	The follower is clearly affected by those close to her, but from what I know there is not much wiggle room in Skyrim to change how followers fight different foes apart from choosing melee, ranged or magicka. So the only aspect that I would find lacking is how the follower interacts with the player based on their accomplishments and deeds, and maybe she could use a bit of backstory. However, in terms of combat adaptiveness and routine, it's pretty cool that her mood changes with the interactions she has.
<b>12.</b>	I think that willingness to seek out and talk to other NPCs - sociability, should wary too.

Table 4.2.ii. Table showing the answers for the twelfth variable

The Twelfth variable was a more descriptive question which asked testers to comment on behaviours they found lacking in the follower. A quick synopsis of the answers can put the feedback into 3 main categories.

The first category took this opportunity to comment on the bugs they faced during their play through. Only a small amount of testers, around 1 or 2 fit into this category. Upon further inquiry, the researcher reached the conclusion that these bugs occurred due to an incompatibility with one of the other mods available for Skyrim, namely open cities Skyrim. While it makes locating the follower cumbersome at times, it doesn't affect or break the main AI related workings of the mod.

The second category consisted of testers who were neither here nor there, they reported that the mod performed as it was expected to however they cannot suggest any additions or changes as this kind of mod would either not be their first preference, or that the amount of unpredictability this mod added was enough for them already.

The third category can be categorised as long-time hard-core gamers that have been modding and playing videogames for quite some time. They had some good feedback which was taken into account and discussed later in the future work section.

### 4.2.13. Question 13

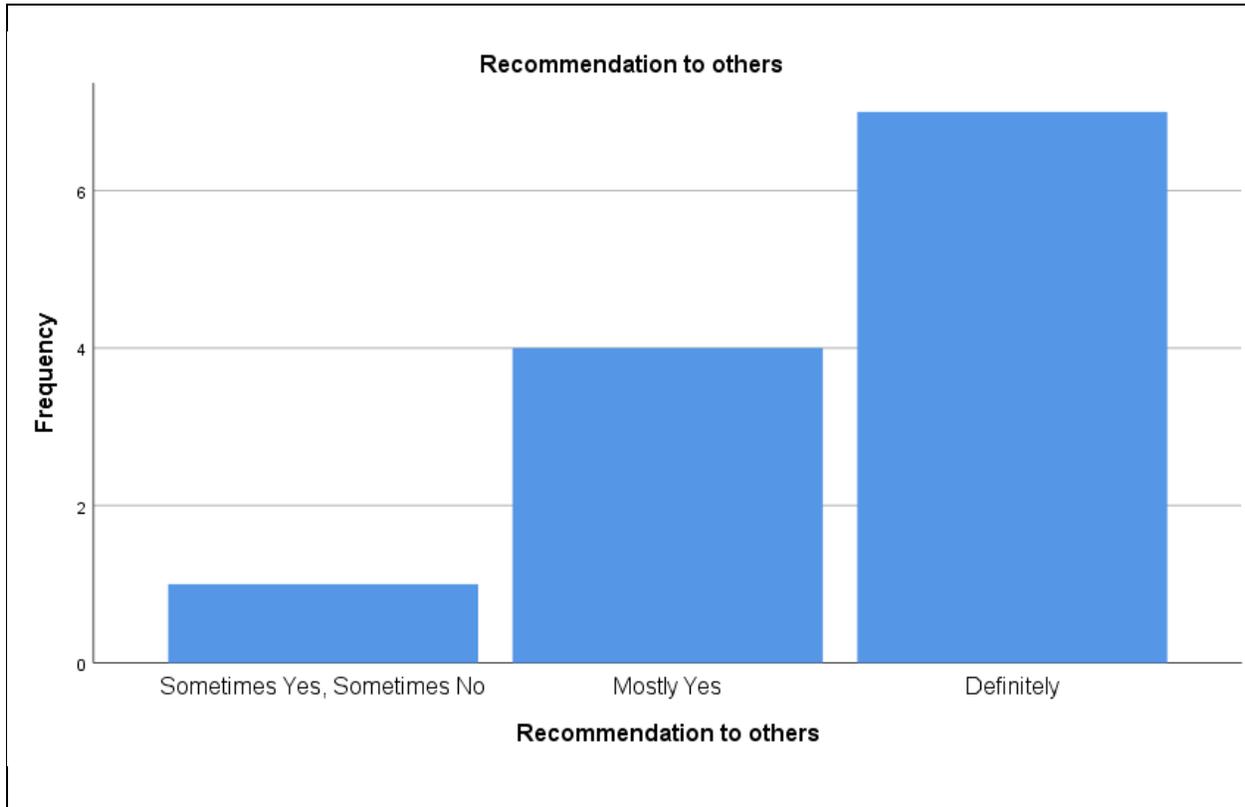


Figure 4.2.xiii. Graph showing the frequency of answers for the thirteenth variable, “Recommendation to others”

The final question asks the testers if they would ever recommend this Mod to other to play. This question was asked in order to gauge if such a Mod was even something there was a demand for. While there are many other follower mods available, there aren’t many which explore the possibilities discussed in this research.

The results of the graph above show that the majority testers voted “Definitely”.

### 4.2.14. Correlation

After having reviewed what the results for each variable or question were independently, it was time to evaluate whether they had any relations with each other. Judging some of the answers received by testers, it was very likely that this may have been the case. In order to confirm these suspicions, a correlation matrix was created of all questions excluding question twelve.

		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q13
Q1	Pearson Correlation	1	-.220	.457	-.095	.312	-.176	-.167	.268	.319	.429	.523	.339
	Sig. (2-tailed)		.492	.136	.769	.324	.584	.603	.400	.313	.164	.081	.281
	N		12	12	12	12	12	12	12	12	12	12	12
Q2	Pearson Correlation		1	.270	-.039	-.161	.364	.208	-.204	.132	-.645*	.026	-.701*
	Sig. (2-tailed)			.397	.904	.617	.245	.518	.525	.683	.024	.935	.011
	N			12	12	12	12	12	12	12	12	12	12
Q3	Pearson Correlation			1	.291	.657*	.245	.308	.086	.547	.120	.391	.000
	Sig. (2-tailed)				.359	.020	.442	.330	.789	.066	.711	.209	1.000
	N				12	12	12	12	12	12	12	12	12
Q4	Pearson Correlation				1	.557	.329	.687*	.516	.466	.139	.148	.303
	Sig. (2-tailed)					.060	.297	.014	.086	.126	.666	.647	.339
	N					12	12	12	12	12	12	12	12
Q5	Pearson Correlation					1	-.059	.245	.103	.514	.357	.187	.414
	Sig. (2-tailed)						.856	.442	.749	.088	.254	.561	.181
	N						12	12	12	12	12	12	12
Q6	Pearson Correlation						1	.378	.308	-.067	-.059	-.221	-.255
	Sig. (2-tailed)							.226	.331	.836	.856	.491	.424
	N							12	12	12	12	12	12
Q7	Pearson Correlation							1	.200	.341	.000	-.060	-.059
	Sig. (2-tailed)								.534	.278	1.000	.853	.855
	N								12	12	12	12	12
Q8	Pearson Correlation								1	.296	.413	.465	.524
	Sig. (2-tailed)									.351	.182	.128	.080
	N									12	12	12	12
Q9	Pearson Correlation									1	-.047	.603*	.203
	Sig. (2-tailed)										.885	.038	.527
	N										12	12	12
Q10	Pearson Correlation										1	.327	.828**
	Sig. (2-tailed)											.300	.001
	N											12	12
Q11	Pearson Correlation											1	.474
	Sig. (2-tailed)												.120
	N												12
Q13	Pearson Correlation												1
	Sig. (2-tailed)												
	N												

\*. Correlation is significant at the 0.05 level (2-tailed).

\*\*. Correlation is significant at the 0.01 level (2-tailed).

Table 4.2.iii. Table showing the correlation matrix of all the results excluding Question 12.

From the Correlation matrix above, we can see that Q1, “Duration of the play through” has a strong correlation with Q11, “Behaviour in terms of adaptability to the situation” at  $p = .523$ . This tells the researcher that those testers who played the game with the mod for longer, noticed adaptive behaviour much more than those who didn’t play for very long. There is also a significant correlation between Q2 and Q10 at  $p = .645$  and Q2 and Q13 at  $p = .701$ . This means that testers who were able to find the Mod’s Follower easily were also likely to suggest such behaviour be applied on base game followers and also recommend the Mod to other people.

Having reviewed other correlations, it would appear that the instrument was more than reliable and also helped testers re affirm and build upon their initial opinion of the mod. This is good as it allowed testers to give feedback with less constraints and clearly, which in turn helped the researcher evaluate in what aspects the Mod excelled and where there were shortcomings.

### 4.3. Discussion of Evaluation

The research was started with the question in mind that:

*Is it possible to Show adaptive behaviours in followers in the elder scrolls v: Skyrim?*

The research question was made this specific in order to reduce external variables, the fact that we explored the possibility on only followers in a specific environment like that of Skyrim made sure that there would be as less outliers as possible. It also helped in controlling all the variables and only focusing on answering the research question.

A Questionnaire was designed keeping this in mind. Therefore, the purpose of the questionnaire was to evaluate whether the researcher had in fact succeeded in showing adaptive behaviour, even if to a degree.

The results collected from said instrument were then evaluated separately and collectively. However, it must still be noted that the tests are very subjective in nature as they only collect the opinions of the testers on a statistical scale. While the process of collecting this information is absolute, that doesn't change the fact that the results collected are only point of views.

Knowing this, we can say that enough point of views statistically aligned can allow the creation of a conclusive statement which could rightly describe the success of the research. With that in mind, Two general statements can be made:

1. It is **NOT** possible to show adaptive behaviour in followers in the elder scrolls v: Skyrim.
2. It **IS** possible to show adaptive behaviour in followers in the elder scrolls v: Skyrim.

The general trend seen in the results collected seems to skew towards the second statement. This means that based on the results of 12 testers, we can suggest that showing adaptive behaviour is possible in the defined confines, however it cannot be said so definitively without further testing on a much larger scale.

## **5. Conclusion**

At the beginning, it was established that the aim of the research was to explore the possibility of showing adaptive behaviour in pre-established AI frameworks present in videogames. One of the objectives to achieve said aim, was to examine the numerous ways, additions could be made through the creation kit. The researcher can say that this objective was met firmly, as the creation kit allowed the addition of some level of behavioural changes by way of scripts. Another objective was to critically evaluate by way of a statistical instrument, the success of this project. The trends observed in the graphs and tables shown in Chapter 4 would most certainly suggest that the project was successful. This ultimately allows the researcher to suggest that showing adaptive behaviour in a pre-defined framework like that of Skyrim, at least, is possible.

## 6. Future Work

This mod fulfils its requirements in its current state, however, this does not mean that it can't benefit from more work.

Further development can go forward in two ways. One being that the functionality is expanded upon in a way that it can be put onto a number of NPCs to allow for adaptive behaviour on other followers as suggested by many testers during testing. The alternative would be to further develop the functionalities specifically tailored to the custom NPC of the mod and create a plotline for the NPC, which was also suggested by some of the testers. The following proceeds to expand on the latter.

### 6.1. Possible Improvements

#### 1. More varied behaviours

The creation kit allows already existing AI packages (which are behaviour trees, essentially) to be used as templates to create new packages from. A lot of the elements may remain same, but key components can be changed to create packages specifically tailored for an NPC or Faction in the game.

Keeping this in mind, a few different packages could be designed for the follower to allow for the possibility of more varied behaviour. This would add another element of unpredictability, but may also increase the number of things the follower can do, which might have an adverse effect and some activities would just never take place.

#### 2. Scripts can be re written following a class based structure instead of Functional Programming where everything is in the main script.

As of now the main script works on a lot of nested If statements. Albeit a bit difficult to achieve this feat, due to some adverse issues experienced with the papyrus scripting language, it would make the system more robust if the sections were separated off into separate scripts. This would also create a more modular base for further development on the Mod.

#### 3. The Relationship chart can be increased to allow a larger number of people to have an effect on the follower.

The follower, currently, only reacts to the presence of 4 other NPCs. It would obviously be beneficial and a natural progression from this point to add more NPCs that could affect the Mod's Follower.

#### 4. The follower has random conversations. It could have some sort of an effect?

The follower chooses to have conversations with a few members of the companions at random times. It will add to a more immersive experience, if these conversations played a part in the reactions of the follower by increasing or reducing the effects of the personality.

## **6.2. Possible Additions**

### **1. Inigo style follower**

There is a follower mod available for Skyrim known as Inigo. It is unique in the sense that it does not count as a follower whereby allowing you to have someone else come with you as an adventurer. The Mod's Follower could also be given such functionality in order to allow for more than 1 follower at a time.

### **2. Have the player's relationship affect her as well?**

It would be beneficial to have some sort of relationship with the player such that there could be random things the follower can do and a new routine they can get used to in the new environment. E.g. can ask the follower to move into your house if there is room.

### **3. The follower could show a change in behaviour based on the weather in the game**

Weather can act as a powerful catalyst having a unique effect on a person based on its state. The same element can be shown in the follower by having the current weather amplify or reduce the effects of a shifted personality much like the random conversations.

Some of these elements are advanced and more complex to implement, however, they are all possible to do so through the creation kit.

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# 8. Appendix

## Mod Feedback Form

Thanks so much for adventuring in Skyrim with Rexley (the follower), kindly take a moment to tell me about what you observed in the Follower.

\* Required

1. **1. What is the duration of your play-through? \***

*Example: 4:03:32 (4 hours, 3 minutes, 32 seconds)*

2. **2. Was the follower, Rexley, Easy to Find? \***

*Check all that apply.*

Yes

No

3. **3. Did you notice a change in behavior of the follower compared to vanilla followers (Base Game followers)? \***

*Mark only one oval.*

	1	2	3	4	5	
Not at all	<input type="radio"/>	Definitely				

4. **4. Did this behavior have a noticeable effect on the day to day routine of the follower? \***

*Mark only one oval.*

	1	2	3	4	5	
Not at all	<input type="radio"/>	Definitely				

5. **5. Did you notice a change in the preferred combat style of the follower? \***

*Mark only one oval.*

	1	2	3	4	5	
Not at all	<input type="radio"/>	Definitely				

6. **6. Did you notice a shift in confidence of the follower in terms of confronting enemies? \***

*For instance, in some behaviors, the follower would initiate combat with enemies while in others, would choose to run or hide?*

*Mark only one oval.*

	1	2	3	4	5	
Not at all	<input type="radio"/>	Definitely				

7. **7. Did you notice a change in appearance as a result of change in behavior? \***

Mark only one oval.

	1	2	3	4	5	
Not at all	<input type="radio"/>	Definitely				

8. **8. Would you say that the follower appeared to be more aware of the people around her? \***

Mark only one oval.

	1	2	3	4	5	
Not at all	<input type="radio"/>	Definitely				

9. **9. Did you feel that the follower's reactions appeared to be somewhat human? \***

Think of this as if you were in the same situation as the follower and had similar relationships, would you behave in a somewhat similar manner?

Mark only one oval.

	1	2	3	4	5	
Not at all	<input type="radio"/>	Definitely				

10. **10. Would you argue that it would be a beneficial addition to have similar affects appear on Vanilla Followers as well? \***

Mark only one oval.

	1	2	3	4	5	
Not at all	<input type="radio"/>	Definitely				

11. **11. Would you agree that the behavior of the follower showed the capability to adapt to the situation? \***

Mark only one oval.

	1	2	3	4	5	
Not at all	<input type="radio"/>	Definitely				

12. **12. What adaptive behaviors come to your mind that you found lacking in the follower? \***

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**13. 13. Would you recommend this mod to other Skyrim players? \***

*Mark only one oval.*

	1	2	3	4	5	
Not at all	<input type="radio"/>	Definitely				

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