Personality-Based AI Behaviour System for Non-Player Characters

GDEV60001 GAMES DEVELOPMENT PROJECT

Olivia Barnett
SUPERVISOR: JAMES VICKERS
SECOND SUPERVISOR: CRAIG WEIGHTMAN

Contents

1. Abstract

World-building in video games is an important part of building immersion and a connection to the experience for the player. An effective way to make a world feel real and lived-in is the inclusion of non-player characters (NPCs) that exist among the surroundings. They can be interactable or simply decorative, but their presence can help the player become more engrossed in the game they are playing if their behaviour is programmed effectively. While the inclusion of NPCs can greatly help immersion, repetitive or unrealistic actions can break the illusion of them being realistic or intelligent, potentially making immersion worse. This paper investigates how a dynamic personality system based on the Myers-Briggs Type Indicator (MBTI) could be applied to NPCs to aid and enhance behavioural realism. An artefact has been created in Unreal Engine 5.6 as a Blueprint prototype that defines all sixteen possible personality outcomes of MBTI as components that can be attached to any character to affect their automated behaviour. Characteristics and needs have numerical values attached to them that decline at different rates depending on the personality type, and the NPCs' behaviour will be dependent on which of their needs most needs to be satisfied at the time. The artificial intelligence (AI) that controls each NPC's behaviour is controlled through a blueprint state machine that follows a MARPO model, with a long-term queue and a reactive queue that determine the next task that the character should execute. The paper will discuss the implementation of the personality system and the research that led to it, as well as discussing the obtained results that prove this to be a viable way of creating dynamic NPCs.

2. Introduction

In many video games, particularly those with an open-world setting or a simulation theme, non-player characters (NPCs) exist in the setting for world-building purposes. These characters, while sometimes able to be interacted with by the player, are often not vital to any story or gameplay progression, but rather exist to provide a sense of realism and immersion to the player. As a feature usually not at the forefront of the game development process, the behaviour of the NPCs can often be stale or repetitive; once this is noticed by the player, it can break the engagement that has been formed. This work aims to develop a dynamic and interesting system that maintains engagement through providing a more immersive experience. The way this will be achieved will be by creating a personality system based on the Myers-Briggs Type Indicator model that can be attached to NPCs and will impact their decision-making behaviour within a finite state machine.

3. Aims and Objectives

3.1 Aims

This project aims to design, implement and evaluate a personality-based behaviour system that is capable of producing distinct NPCs easily distinguishable from others within the simulated game environment. The manner in which this will be researched will be through the creation of an artefact that provides spawned NPCs each with their own personality. These personalities will be based on the types defined by the Myers-Briggs Type Indicator, a trait-based personality model that breaks down a person's disposition into one of sixteen four-letter acronyms.

3.2 Objectives

To solve the problem at hand, this paper aims to answer three main questions:

- **Objective 1: To create NPCs with substantial observable differences in behaviour that make them feel distinct from one another**
  The overall aim of the project is to demonstrate the improved world-building that occurs as a result of varied NPC behaviours. The different personality types must have perceivable differences in their task performance and execution frequency as a minimum in order to consider this objective a success.
- **Objective 2: To create a system that can be easily attached to any NPC**
  The best way to utilise the system would be to use it as a tool for easy world-building. Open-world games in particular would benefit from an uncomplicated way to set up NPCs that have the capacity to act like dynamic, intelligent beings with little adjustment. The personalities should be created so that they can be attached to an NPC, granting the ability to perform differently depending on personality-based needs.
- **Objective 3: To aid player immersion with the simulation through the inclusion of sixteen different personality types**
  For this objective to be a success, the NPCs need to perform differently enough from one another to be captivating. This objective differs from Objective 1, however, by having an emphasis on holding the viewer's attention; the behaviour of every unique NPC needs to be unique enough that the user feels the need to watch different characters for a while each.

4. Literature Review

4.1 Personality Psychology

4.1.1 What is personality?

Uniqueness in any given individual will come from their own personality, the analysis of which has been the basis of many psychological studies. Roberts & Yoon (2022) define personality as an individual's consistent characteristics, as well as their reflexive thought and behaviour patterns in response to various situations. Though the concept of every person having their own individual personality has existed for decades, there have been several different studies that investigate ways in which they can be explained, through factors such as brain structure or traits. Each theory has merit, and the decision as to which is best is situational; for example, someone looking into personality between familial generations may choose to focus on a neurology-based theory, whereas somebody attempting to represent more specific aspects of personality may be more interested in traits.

4.1.2 Theories of Personality

4.1.2.1 Psychodynamic Theory

Popularised by Sigmund Freud in the 1890s, psychodynamic theory suggests that a person's self can be defined with three different provinces: the id, the ego, and the superego. The id is the most primitive province, and its only goal is to seek out what will bring the most pleasure, disregarding any warning or reason. Working alongside the id is the ego which, too, seeks pleasure, but does so in accordance with reality; it acts as the centre of logic and reasoning. Finally, the superego acts as the mind's conscience, striving for perfection and moral gratification (Lapsley & Stey, 2011). Freud's theory posits that every person will be born with only id, and the ego and superego develop as they go through life and encounter different people and situations, suggesting that it is experiences that affect the person, rather than the inverse. (Pelz & Overstreet, 2019)

4.1.2.2 Humanistic Theory

Self-actualisation is the basis for humanistic personality theory – the idea that someone's personality is dependent on how they think of themselves. Explained by Wong (2006), an individual will experience much internal conflict from the day they are born, and the manner in which they choose to resolve these conflicts will be reflected in their exterior personality.

4.1.2.3 Social Theory

Humans as a species are more complex and intelligent than any other on the planet, and social theory uses these complexities and cognitive elements to explain human behaviour (Lester 2019). Development of social learning theory was carried out by Julian Rotter in the 1950s, and its main focus is the idea that humans are motivated by the excitement of reward or fear of punishment, and their outward personality will present itself differently depending on how they respond to these stimuli (Rotter 1982).

4.1.2.4 Evolutionary Theory

Evolution as a cause for personality is explained by relating characteristics and behavioural patterns to humanity's adaptive landscape. This is most prevalent in looking at the differences between males and females: according to Figueredo et al. (2015), males have been found to devote more effort into social dominance and risk taking, while women may be more concerned with nurture. Environmental and genetic differentiation through the centuries may have conditioned human minds to work in certain ways, influencing people's personalities (Volk & Puchalski, 2025).

4.1.2.5 Trait Theory

Trait theory stands as one of the most highly researched theories of personality. The approach surrounds aspects of a personality being broken down into traits: characteristics that can be present to varying degrees in different people. Consistency over various situations and time passages is key to defining a trait, recognised by repeated patterns of behaviour and emotions in response to different situations (Novikova 2013).

4.1.3 Trait-Based Personality Models

4.1.3.1 Gordon Allport

The trait-based approach to personality was first introduced by Gordon Allport in 1936 with a paper that suggested that personality traits can be organised into three categories known as dispositions: the most typical kind of dispositions are central dispositions, traits commonly presented by the individual in everyday life. Additionally, there are secondary dispositions – traits that are less obvious and are only noticeable in certain situations – and cardinal traits, which are dominant and overpowering, therefore not present in most people (Novikova 2013). Rather than personality being something random, Allport's study proposed that roughly two thirds of a person's temperament is defined by their environment, while the other third is down to heredity (Rahmawati 2025). Allport's trait theory was praised for its organised categorisation of personality into a structure of traits and attitudes that is easy to analyse (Ismanto 2024).

4.1.3.2 Carl Jung

Carl Jung published a book in 1921 claiming that the widely accepted idea of personality – that personality was random and purely biological – was less likely than his theory, that differences in personality between different people were so consistent that they could instead be categorised into "types" (Stein & Swan, 2019). Unlike most other personality theorists at the time, who were trying to understand what made each person different, Jung was more interested in how they were the same (Stevens 2012), and how aspects of every personality could be linked together. Jungian theory

suggests that human behaviour is built upon four different psychological functions: sensing, intuition, feeling and thinking. According to Francis & Ross (2018), the functions can also be further categorised into two more overarching types: the perceiving functions, sensing, and intuition; and the judging functions, feeling and thinking. The main differences between the judging functions are that the thinking function represents active thinking, which feeling represents passive. An individual leaning further towards feeling may take a calmer and more relaxed approach to their thoughts, compared to a thinking individual, who may become locked onto a thought (Murray et al., 2020). Meanwhile, the distinctions between the perceiving functions can be made in terms of realism; intuitive people tend to be more fanciful and imaginative, while those leaning towards sensing will be more grounded and realistic (Blutner & Hochnadel, 2010).

4.1.3.3 Hans Eysenck

Hans Eysenck's combined biological and trait-based model was created in 1947; a personality model following trait theory with three separate parts: neuroticism, extraversion/introversion, and psychoticism (Knežević et al. 2019). These three parts are linked to brain circuits – networks of neurons in the brain that perform specific tasks – explicitly linking Eysenck's theory to biological theory as well as trait. Matthews (2016) pairs extraversion/introversion to a cortico-reticular circuit, related to alertness; neuroticism with a cortico-limbic circuit, which works with emotion; and psychoticism with both, causing impulsivity. Extraversion/introversion was defined by Eysenck (1947) as, at an extreme, being prone to hysteria or depression, respectively. On a smaller scale, this can be described as extraverts being more confident and upbeat in general situations, whereas introverts may be more reserved and quiet. Neuroticism is reflective of emotional instability and anxiety, and psychoticism represents anti-social behaviour and aggression (Revelle 2016).

4.1.3.4 Five-Factor Model

Also known as the Big Five, the Five-Factor Model (FFM) has been developed over many decades by various researchers, such as Ernest Tupes, Donald Winslow Fiske, Paul Costa Jr., and Robert R. McCrae. It breaks down personality into five distinct dimensions: extraversion, agreeableness, conscientiousness, neuroticism, and intellect. These dimensions are defined by Goldberg (1993) as such:

- Extraversion differentiates sociability and social reservation
- Agreeableness differentiates cooperation and antagonism
- Conscientiousness differentiates structure and disorganisation
- Neuroticism differentiates proneness to negative emotions and emotional resilience
- Intellect differentiates a broad variety of interests and routine familiarity

Soto & Jackson (2013) state that FFM was developed to categorise human personality succinctly in few traits, while still representing as much variety between personalities as possible. FFM has been well received across all fields as it has been found to successfully describe almost every exhibitable trait (Widiger & Crego, 2019), but criticisms have been made, arguing that it is not broad enough. Notably, researchers Ashton & Lee (2007) made a case that five dimensions is not substantial to thoroughly cover all human complexities – specifically morality. They argued that none of the defined traits allow for the concept of ethical decision making and could therefore misrepresent participants and how they display their own goodness.

4.1.3.5 Myers-Briggs Type Indicator

Building primarily on the work of Jung, the Myers-Briggs Type Indicator (MBTI) suggests that human personality can be broken down into sixteen distinct personality types (King & Mason, 2020). These

types each are represented by four letters, with two letter options for each position, that refer to a different aspect of the participant's personality:

E/I → extraversion/introversion

N/S → intuition/sensing

F/T → feeling/thinking

J/P → judging/perceiving

Bharadwaj (2018) defines each respective set of letters as how outgoing a person is; how they perceive information in terms of making inferences; whether they use logic or emotion in decision making; and how spontaneous they are compared to structured. MBTI was developed by Katharine Cook Briggs and Isabel Briggs Myers in 1943 in order to create a highly simplified way of removing the randomness of human personality (Wang et al. 2023). It has been widely used in studies and research over other trait-based personality models for being easy to understand and its distinct categorisation; having a defined personality type to represent a person's mind can provide a better sense of understanding their own self (Ma, 2025).

Some academics criticise MBTI for being unreliable; Pittinger (2005) argues that most of the explanations behind the model is purely theoretical, and there is not enough empirical evidence to support its claims. He also argues that the accuracy of the categorisation of people into the different personality tests can be inaccurate, due to poor test-retest reliability. Furthermore, Arnau et al. (2003) assert that MBTI categoric structure is too rigid to faithfully represent aspect of a human's personality, stating that aspects of personality are better to be represented as continuous traits. However, despite its psychological constraints, a study conducted by Lepri & Lepri (2018) found that the definite organisation of MBTI's sixteen personality types is much better suited to solving computational problems, due to its categoric nature aligning with classification-based algorithms. Its ease of translation compared to spectrum-based models such as FFM makes the ideal trait-based personality model on which to build a simulated personality system in a program.

4.1.4 Myers-Briggs Type Representation in People

Every letter in MBTI personality types works together with the others to define an individual's personality type, but there is a distinction between the simple definitions and how they display themselves in humans. To further relate the personality types to human behaviour, the types are often given profile names – an encapsulation of the personality in a describing term. Researcher Kroeger (2013) has defined the following profiles as guides to understanding the different personality types:

- The Organiser (ISTJ)
- The Facilitator (ISFJ)
- The Visionary (INTJ)
- The Inspirer (INFJ)
- The Crafter (ISTP)
- The Dreamer (ISFP)
- The Idea Mill (INTP)
- The Muser (INFP)
- The Realist (ESTJ)
- The Teacher (ESFJ)
- The Commander (ENTJ)
- The Persuader (ENFJ)

- The Adventurer (ESTP)
- The Entertainer (ESFP)
- The Brainstormer (ENTP)
- The Socialiser (ENFP)

By defining the types in this manner, it becomes easy to predict how an individual may act based on their MBTI type.

Some researchers, however, go further with the categorisation of the sixteen personality types and split them into four groups of four. The most popular categorisation of this manner was created by psychologist David Kiersey in 1978. He gave names to each different personality type, just as Kroeger did, but he then grouped them together using alike traits in a system called the Kiersey Temperament Sorter (KTS), and he gave these groups names that describe their temperament: the Artisan, the Guardian, the Rational, and the Idealist (Kiersey & Bates 1986). Neal and Neal (2009) discuss how each temperament represents itself through people, stating that those with a Guardian temperament are likely to take charge of situations, with a focus on logistics, supervision, or protection. Rationals are also logical, but rather than a concern with leadership, will pursue knowledge and will constantly be setting and completing goals for themselves or others. They, as well as Idealists, find fascination with abstract ideas instead of the more tangible ones preferred by Guardians and Artisans – Idealists, however, differ from Rationals by prioritising personal growth and authenticity to themselves over knowledge – their morals are the most important to them. Meanwhile, Artisans are spontaneous and adaptable people who seek efficiency and immediacy of results. Though split into groups of four, the distribution of the temperaments in the population is not even: Guardians are the most prevalent, making up 45% of the population; Artisans make up 30%; Idealists make up 15%; and Rationals are the least common, with the temperament only being seen in 10% of the population (Kiersey, 2004).

4.2 Artificial Intelligence

4.2.1 What is Artificial Intelligence?

Computers inherently can only do as they are told, and upon creation were simply tools for humans. As technology has progressed, however, it has become more desirable for a computer to act almost as its own entity – being able to create its own answers to questions and work with people, rather than for them. Artificial intelligence (AI) was introduced in the 1950s, and was defined by pioneer John McCarthy (1955) as a way to try and make computers perform intelligently. Its most beneficial aspect over humans is the speed and efficiency at which tasks can be performed (Shekhar 2019), allowing for easy advancement in production time in addition to realisation of concepts – use of AI can make more complex or novel ideas exist faster than a human could be able to. Uses for AI have developed over the years, and in the present day, the aim of AI research is to develop the capabilities of computers to be able to complete tasks that are typically more successfully performed by humans (Rich & Waters, 2014). Significantly, this can be used in creating computer-based entities. Non-player characters (NPCs) are entities in video games or simulation that can act and behave like a sentient being. Since they have no conscience, the beings' actions must be controlled by computer programs – artificially creating a conscious intelligence. The ability to create characters that give the illusion of being capable of their own decision is crucial to games and simulations that focus on world-building or real-life experiences; an accurate depiction of society requires NPCs that will act in natural ways that the user will expect (Iwata, 2009).

4.2.2 Finite State Machines

The most widely used AI model for NPCs in games has typically been finite state machines (FSMs). This model is represented as a graph with its nodes known as states, connected by transition lines. Each transition must lead to another state, so that functionality can flow from one to the next. Transitions have rules that must be completed for the program to move on, and these are constantly checked against to see whether the condition has been completed (Jagdale 2021). FSMs are used to prioritise conciseness and efficiency over regular code; instead of having to write large amounts of if statements, potentially leading to redundancies or repeated code, an FSM can instead be used to more easily transition between states, allowing the NPC to switch between different behaviours with as little processing as possible (Hajji et al. 2022). Olejár & Szabari (2023) describe the compactness and modularity of FSMs as an advantage, as it improves legibility in generally large and complex systems. Conversely, disadvantages of FSMs are laid out by Wintner (2008); they can often be restrictive due to their finite nature, as not every situation can be accounted for with limited number of states. Additionally, it can be challenging for multiple developers to work on due to the inflexibility of the states themselves. This, however, is far less of an issue for solo developers, and thus finite state machines prove to be a good option for teams of small sizes.

4.2.3 Behaviour Trees

An alternative to FSMs is behaviour trees, a method of task control that takes a modular approach to artificial intelligence (Colledanchise & Ögren 2018). Developed by Geoff Dromey in 2001, behaviour trees have been popularised due to their simplicity and modularity that allows for easy testing and alterations (Iovino et al. 2025). Colvin & Hayes (2010) describe the structure of the behaviour trees: an origin node at the top that branches off into new nodes with their own functionality. These nodes can then also have their own branches – the final graph will take the shape of a tree. The growth in popularity of behaviour trees stemmed from their use in *Halo 2*, a game series published by Microsoft. Discussed by Isla (2008), the AI in the *Halo* games is structures using a tree of prioritised, self-describing tasks. Subtrees are considered as fragments, and those that are active are assigned a top priority, and the flow of execution travels along the branches to meet it.

Over FSMs, behaviour trees have the advantage of scaling well, whereas FSMs reach a stage where they contain too many transitions; researchers Iovino et al. (2025) have concluded that while behaviour trees scale linearly, FSMs scale quadratically. However, although behaviour trees have a benefit of readability to those familiar with AI methods, due to their clear task hierarchy, they are overall less intuitive than FSMs and therefore may not be suitable for projects by teams with less experience. Furthermore, the setup and management of a behaviour tree can often be more complex than a FSM, indicating that, for a project that must be completed within a short time frame, behaviour trees may not be the best choice. (Iovino et al. 2025).

4.2.4 Fuzzy Logic

Fuzzy logic is a method of building logical reasoning for AI by considering vague or indefinite statements. Rather than taking a piece of data as an absolute, a fuzzy logic approach considers the data as degrees of truth; a statement will be given a value between 0 and 1, where 0 is completely false and 1 is completely true, and the weight of its truth is determined by the specific value it has been assigned (Cintula et al., 2016). In a practical sense, the truth of fuzzy statements is represented with sets, where the degree of truth is a decimal number, and functions in the fuzzy logic must determine which set they belong to (Wang et al., 2023). Dernoncourt (2013) summarises fuzzy logic systems and describes that the system must look at its inputs and the desired output together. Weights of the inputs are considered, and multiple potential calculations are suggested, and the program must make a choice for which route it will choose – this is the defuzzification stage. Once the

path has been chosen, the final fuzzy output is determined. Fuzzy logic was created by Lotfi A. Zadeh in 1965 with the goal of creating human-like and biological logic systems that can make realistic decisions based on imprecise data (Zadeh, 2013). Due to its vague and indefinite nature, fuzzy logic can be useful in representing human personalities, as it accounts for the slight nuances of every individual. Researchers Wang et al. (2023) conducted a study using fuzzy logic alongside MBTI to try and categorise the uncertainty for each personality type, on the basis of the original MBTI test limiting the sixteen personality types to being mutually exclusive. Using fuzzy logic within the MBTI test involves allowing the participants' answers to be less exact, while also being able to adjust any inconsistent answers. The end results give the participants' degrees of how far they fit into each type, instead of providing them with one type to encapsulate their entire personality. As such, the results of using fuzzy logic in the test much better reflect the individuality of the participants, but, in doing so, lose the conciseness that makes MBTI so popular. Therefore, a fuzzy logic approach to MBTI would only be useful in a psychological study; in a project examining personality representation, the classic MBTI approach would be much more suitable.

4.2.3 MARPO and Reactive Behaviour Trees

Building off regular behaviour trees, reactive behaviour trees use two stacks that handle the decision making for the entity. This approach is based on the MARPO - Movement, Avoidance, Routing, Planning and Orders – methodology created by Dr Brett Laming (2008), which uses two stacks of behaviour states to perform the decision. Compared to regular behaviour trees, AI programs created with the MARPO approach have the benefit of fewer complexities; behaviour trees are popular because of their modular nature, but eventually a tree for one type of behaviour could become so large and so detailed that the simplicity that comes with modularity gets lost. By separating the states to be pushed onto or popped from stacks, it remains easy to understand the code regardless of the size of the AI. Reactive behaviour trees take the MARPO methodology and refine it, with one of the biggest distinctions being the number of stacks used: MARPO makes use of a long-term, reactive, and immediate stack, while reactive trees discard the immediate stack entirely. Additionally, the stacks in the reactive approach are not made up of states, but instead self-contained behaviour trees. The long-term stack is the default behaviour for the system and contains what the entity will do while there is nothing to which they should react. If it does need to react to something, however, the relevant tree will be pushed onto the reactive stack to be performed. A tree at the top of the stack can push more trees itself; in this case, the original tree falls dormant while the new top tree is executed. Once it has completed, it gets popped and the dormant tree becomes active once more (Roberts, 2024). Reactive trees are more complex to code than regular behaviour trees but have the added benefit of being far more modular and therefore tidier and more understandable.

4.2.6 Smart Objects

Smart objects are entities which contain the logic for actors interacting with them within themselves. Any functions, animations or audio required to carry out the interaction between a character and a smart object is stored inside of the object to prevent over-complication of the character's logic (Černý et al., 2016). They become useful in games with a lot of interactable objects because it means that each object can stand alone; the programmer will not need to be concerned with any pre-existing scripts to write the logic for a new object, and will instead only have to focus on what effects the new object will have. Geishauser et al. (2014) provide the example of a bed object needing to know about sleeping and waking states, but not about cooking food. They continue and describe that further benefits of using smart objects instead of one big script inside the character are that they allow for easy expandability, since, to add new kinds of objects, the character would not need to be altered at all. This idea is supported by Simpson (2005), who describes how, to create a new kind of chair, the

programmer needs only to expand on the basic chair script. Furthermore, storing the logic in objects means that there becomes a wider range of programmers that can work on interactable actors; in many teams, only a few programmers will work on the character scripts, meaning that some will not be familiar with the functions or variables within them. If all the interaction logic were stored inside the character, it would be difficult for a programmer unfamiliar with the character to make an interactable object, because they would first have to learn and understand how the character works.

4.3 Personality and AI in Video Games

4.3.1 The Sims

The Sims as a franchise is a highly popular simulation game where a player can create their own characters, with customised looks, personalities, interests, and jobs, and watch them exist and live their lives. The appeal of these games is that, as stated by Belk (2014), the player can witness a life other than their own, with different characters that act in diverse ways than they themselves would. Pettini (2021) outlines how personalities in *The Sims* series are built upon trait theory – when creating a Sim, the player is given a selection of defined traits, from which they can choose three to five, depending on the game. The combination of these traits, as well as their likes, dislikes and aspirations, make up a Sim's personality. With the large number of options from which a player can choose, there is potential for hundreds of different combinations that result in hundreds of Sims that are distinct from one another. In doing this, *The Sims'* creators manage to hold players' attention and encourage replay, through the idea that each Sim they make can be unique from the last. These statements are backed up by Game Art and Design scholar Sloan (2015), who describes how *The Sims*' introduction of advanced behavioural variables allows for complex character design and behaviour, with the representation of human personalities being one of the most interesting aspects of the game, highly contributing to its success. From this perspective it can be inferred that the inclusion of dynamic personalities in games or simulations enhances the experience for the player by allowing them to engage themselves in an experience that reflects the real world, but in a way that is different enough from their own that they can create brand new experiences.

The way in which Sims interact with the world is through smart objects, where all the logic is stored in the items themselves. This system is used for almost every aspect of the game, including interacting with other sims, and more abstract systems such as control of the weather (Bourse 2012). Every object on a lot is accessible to any Sim, and they must decide whether they would like to interact with it or not. The smart objects themselves contain all necessary information for a Sim to carry out a task, including any animations or audio that should be played. Among this data is advertising data, which is data that will tell a Sim whether or not they should interact with it. To remain alive, a Sim has six motives that must be maintained – these are Hunger, Bladder, Social, Hygiene, Fun and Energy. The advertising information in a smart object directly relates to these motives and will tell a Sim how many points towards filling a motive they will gain by interacting with it – for example, a bed's advertising information will tell a Sim that they will gain a lot of Energy points from using it, while a treadmill would take a lot away, as well as Hygiene. When a Sim is idle and needs to decide what to do next, they will query the objects around them and will look for the object that will best fill their needs based on their current motives. The most complex motive that can be advertised to is the Fun motive, as actions that will grant fun points will vary depending on each Sim's chosen personality traits. The negative aspect of creating NPC autonomy in this manner is presented in areas with lots of objects; to work out what it should do next, a Sim would have to query every object around them, which could take a long time and use a lot of processing power. Instances such as these, however, can be rectified by telling a Sim to only query a certain number of objects that are close to them, reducing the number of queries that will take place. Furthermore, lots with fewer objects placed within them will not

encounter this problem, so limiting the amount that can exist in an area at one time could also prevent querying issues (Simpson, 2005).

Sims themselves are also smart objects, but are more complex than ones for furniture, due to their own unique traits and the previously discussed autonomy. As such, communications between Sims could become extremely complicated and prone to bugs. To prevent this, a third object is created when two Sims begin having a conversation that handles the logic. It is invisible to the player but contains logic within itself so that it can act as a manager and tell the two Sims what to do. An example scenario would be Sim A existing with a low Social motive. To seek fulfilment, they query nearby Sim B, whose advertising information tells Sim A that by interacting with them, they can gain Social points. The communication handler is then instantiated, and it tells Sim A to walk towards Sim B, while Sim B stands and waits. Once Sim A arrives at its destination, the handler will tell both Sims to start playing their communication animations and to gain social points. Jake Simpson's (2005) description of interactions between artificially intelligent entities provides insight into how advanced smart objects can communicate without over-complicating the process, useful for any game or simulation that contains NPCs that need to control their own conversations.

4.3.2 SimCity

The *SimCity* franchise was the pioneer of city-builder sandbox games, and one of the big reasons for is success was the scale of the cities you could make. In a given area, the player can place functional structures, and zone for residential, commercial, and industrial buildings (Feng et al. 2025). For each of these buildings, people and resources will be needed for them to operate. Hundreds of total buildings can be present in a city, resulting in potentially thousands of people that can roam around the city. Every person has a task to complete, and the way in which this is done in *SimCity* is by representing each person, as well as cars, as agents (Official EA UK, 2012). The simulation engine used for SimCity is Glassbox, which uses resources – represented as variables – to follow rules that will change simulation states (Moskowitz, 2013). An example of such would be production of materials in factories; if the factory does not have the required number of alloy resources, the production rule will be unable to be completed. Information is transferred in the game by agents that hold variables that will allow them to follow rules. An agent is created with a default behaviour which will tell it what to do or where to go if they are not currently completing a task. The default behaviour is dependent on the type of individual that the agent is; for example, a person with high wealth's default behaviour may be to head to a wealthy shop, whereas someone with lower wealth may be a worker heading to a poor factory (Moskowitz, 2013). Since so many buildings can be placed, there needed to be a way to ensure that they were all being visited and that none were being neglected. The way in which this was done was explained by Official EA UK (2012) that buildings requiring attendees could send out a signal that would tell relevant people agents to come them, and the people would then follow their rules upon arrival. In addition to performing tasks, some rules can impact the emotions of an agent, such as people leaving a shop with happiness (Moskowitz, 2013).

A further representation method in *SimCity* was to represent groups of agents and buildings as sinks, so that the program would never need to loop over every agent or unit present in the city. By using sinks, groups of agents can path to their nearest needed sink and will start performing their behaviours when they get close enough to them. When an agent arrives at a sink, they will deposit their held resources and pass them so that tasks can be completed (Earle, 2020). It has been argued by Söbke et al. (2013) that controlling the city in this manner is unrealistic, and therefore not an effective way of representing an urban existence. However, the benefits that creating sinks has on performance and frame rate are so significant that without them, the needed scale for the game would be unattainable (Moskowitz, 2013). A well-known feature of the *SimCity* games is the ability to click on any person in

the world and see who they are and where they are going. While the feature was kept in as a storytelling tool for the player, lead *SimCity* gameplay engineer Dan Moskowitz (2013) explains that the basis for this system was the debug mode in development that would allow the developers to keep track of what each agent is doing and where they are headed. The debug mode would provide the basic information, such as the person's wealth and their destination, and then the developers would take this output and change it into a short sentence to be shown to the player. The background to this system demonstrates how a similar and customisable product could be created by using the specific debug output data of the agents or people in any unique simulation, regardless of the stimuli that may trigger an AI response.

4.3.3 Tomodachi Life

Released for the Nintendo 3DS in 2013, *Tomodachi Life* is a simulation game that centres around player-made characters named Miis that live on an island together. One of the main gameplay elements is socialisation between the Miis, who can form and build relationships with one another; the strength of these relationships is based on the personalities of the Miis involved. The personalities are defined by the player when they create each Mii; after the appearance customisation section is a screen that presents the player with five characteristics: movement, speech, expressiveness, attitude and overall. Below each characteristic is a scale, where the player can choose at what point in the range should the characteristic be. Once the player has confirmed their choices, they will be combined and the Mii will be assigned a personality type. Based on MBTI, there are sixteen personality types, and, like Kiersey's Temperament Sorter, these types are further divided into four categories: easygoing, outgoing, independent, and confident. Furthermore, all sixteen different personality types have their own names as well, such as Easygoing: Dreamer, Independent: Reserved, and Confident: Go-Getter. The depth of the personality system of *Tomodachi Life* and its basis on MBTI types, in addition to its genre of social simulator, makes it a valuable foundation for the creation and development of personality systems for NPCs.

5. Research Methodologies

5.1 Quantitative Research Methodology

Research collected with a quantitative methodology is driven by numerical data and statistics. Examples of what could be gathered include a percentage of participants who agree or align with a provided scenario, or an average value of collected numerical responses. By collecting data of this kind, the researcher gains the ability to find patterns and predict trends based on information accurate to the given study. This can be helpful for drawing conclusions of a general attitude towards a project, or the success of the study itself.

5.2 Qualitative Research Methodology

Conversely, qualitative research uses non-numerical data for research, and instead, for example, focusing on feelings. While less precise and scientific than quantitative, a qualitative approach will take an interest in why the participants might have responded to the questionnaire or other research materials in the way that they did. In addition to feelings, qualitative research can involve feedback provided by the participants, or observations made by the researcher while the study takes place. Benefits of using this methodology include providing those conducting the study with an insight into what took place; they will have a better understanding of why and how the responses they collected were formed.

5.3 Mixed Methodology

A mixed methodology combines the key features of both qualitative and quantitative research for an approach that can collect all kinds of data for the most thorough and detailed results. These can either be performed separately for two exclusive sets of data or used to inform one another; for example, a survey looking for quantitative data could collect a series of responses from different participants. A qualitative survey could then be conducted to gather the participants feelings towards either the project or the quantitative survey. A correlation could then be searched for the non-numerical data gathered compared to the numerical responses they provided. While not appropriate for all projects, those that do use a mixed methodology will allow the researcher to gain a clear overview of their entire project and different possible responses.

5.3 Agile Methodology

The Agile Methodology is a project management technique that break down a development process into short iteration cycles, known as sprints. In a short time frame, the team working on an area of a project will complete all the necessary stages of development, from the initial planning to testing and gathering feedback. Upon the completion of each sprint, a new cycle will begin for a different area of the project. This will continue until the end goal is reached and the main project is complete. Proceeding with development in this manner has multiple benefits: the regular feedback means that the project is consistently aligning with people's expectations, ensuring that the developers are always working towards an outcome that will be received favourably; and the inclusion of several small deadlines that require a bug-free product prevent any errors from going unnoticed until the final stages of the project, where they would be harder to find and solve.

5.4 Waterfall Model

The Waterfall Model is another management technique that works in stages, but it differs from Agile due to the stages needing to follow one another sequentially; the content of each stage continues and directly impacts the next. For managers who want aspects of their project to be completed in a particular order, this method would be the best; for example, the phases of each Waterfall stage could follow the sequence of analysis, design, development, and testing. This method provides a rigid structure to the project development process and ensures that no stage of the project can be missed out or ignored, leading to a full and well-developed result.

5.5 Planned Project Implementation

The project's main level will be a world with several types of buildings. These buildings will be visited by NPCs, each of whom have a different personality assigned to them. The actions of the NPCs will be controlled by needs, the intensity of which will be stored within each of the separate personality types. The needs that will be considered are Social, Fun, Education and Relaxation, and these have been chosen based on the distinctions observed between types by Bharadwaj (2018), and because their distinctions from one another will allow the prototype to represent the varied characteristics of each type. The capacity of these needs will decrease over time, and once they fall beneath a certain threshold, the NPC will execute a task that will help them to refill the low need; needs of higher strengths will fall beneath the threshold more slowly and less regularly. To solve their problem, the NPC will query the buildings in the world and travel to one that will help them to return the need to its maximum value. When all needs are above the threshold, NPCs will wander around the map, travel to their unique favourite location, and have conversations with other characters around them. Depending on their conversation partner and the compatibility between the two, the outcome of this interaction will result in the NPCs feeling happy or angry, which will, in turn, affect the selection of

their next task; for example, if an NPC is angry, they will then travel to their favourite location in order to make themselves feel better. The human using the project will not have any effect on the NPCs once they have been spawned; they are permitted only to watch the simulation and observe how the different personalities represent themselves. To aid this inspection, the user will be able to click on any NPC to create a widget that displays above their head and provides information about their personality type, their current needs, their emotion, and the task they are currently completing. There will also be a button on which they can click to focus the camera on the selected character so that they can be followed.

The project will be managed by using the Agile Methodology, with a series of small deadlines to be met throughout the duration of the sixteen-week project. A Gantt chart will be created to structure the project's timeline and allocate time to each task. The first portion of the project will be dedicated to research and understanding of the question and its background, in addition to the planning of the artefact solution. The second portion will revolve around the creation of the artefact to support the research being conducted. This will be broken down into stages that will take, on average, a week each. Following the completion of each stage, the artefact will be considered as a whole to ensure that it is working without error at that point. Following the completion of the artefact, the remaining time will be split up to allow for testing, collection of data, and an analysis and overview of the finished project. An agile methodology suits this project better than a waterfall methodology because it will be completed less sequentially than a waterfall methodology would require; some aspects of the artefact are more important to the final result than others, and, due to the short time-frame, will need to be completed early in the development process to ensure that it is implemented successfully.

5.6 Chosen Research Paradigm

The short research study being conducted will use a three-question survey aiming to collect quantitative data. The questions that will be presented to participants are as follows:

- **Question 1: How would responses to a large social gathering differ between those with an I (introversion) and those with an E (extraversion)?**
- **Question 2: Rank personality types in order from most to least likely to go somewhere other than home after work.**
- **Question 3: Which of the four groups of personality types to you think is likely to have the highest emotional variability?**

The aim of this questionnaire is to obtain information about how the different personality types should be represented in accordance with chosen needs. Since the questions are being presented to attempt find an average response that can be used for the representation of the different personality types, quantitative research is more appropriate; the responses from participants should be objective rather than subjective.

Responses to Question 1 will be used to influence the social need and the conversation tasks. Since all the NPCs will exist together in the same level, they will all be available to converse with each other. The answers to this question will determine whether or not NPCs of different types – particularly those who are introverted compared to extraverted – should have conversations at the same rate. If participants state that there would be a significant difference in response, it can be determined that some types should have a cooldown period before they can converse again.

Question 2 will gather information about the rate of task execution for different personality types, as well as informing the maximum values for the relaxation needs. Types ranked to be less likely to go somewhere after work will be given a higher maximum relaxation value, as it can be inferred that they

prioritise rest over going to many different places. Those ranked to be more likely to go somewhere after work will, in addition to having a lower maximum relaxation value, will move between tasks more rapidly. This could be represented by all maximum needs being lower than those at the bottom of the scale, or by an increased movement speed.

Finally, Question 3 will help to influence the emotions given to the NPCs. The temperament that is decided on average to have the highest emotional variability will have their emotions change more frequently. This could mean that they are compatible with fewer personality types than other temperaments, which would lead to them becoming angry more often. More frequent anger would lead to the NPC travelling to their favourite location more often, which would then change their mood once more.

5.7 Planned Testing

The goal of the project is to have created a range of personalities that, when applied to an NPC, will result in observable differences in their behaviour. Noticing the differences is the most important aspect, so the testing will revolve around watching characters of various personalities and observing what they do and how often they do it. A table will be created in a spreadsheet to store the data that has been collected from the activities of the NPCs. Their temperament and personality type will be entered into the table, and information about the tasks they complete and their current emotion will be stored as they change. Using the button to focus the camera on a particular NPC, the researcher will follow an NPC for a determined period – for example, two minutes – and any change in task or emotion will be stored along with the time at which it executes. This process will be repeated three times for each selected personality type, and NPCs of different types must be tested – as a minimum, one personality type of each temperament must be focused.

5.9 Planned Data Analysis

Recorded data for a certain type will first be compared against each of its iterations in order to detect any anomalies. If the data is incoherent, the testing process should be repeated. Once the data has been determined to be reliable for every tested personality type and temperament, the results must be compared to spot patterns. For the project to be considered a success, the personality types need to be distinct from one another, but should also align reasonably with other types with similar traits. Kiersey (2004) developed the KTS by sorting the sixteen different MBTI types into groups by considering like characteristics. As such, personalities represented in the NPC Personality System should result in behaviours that are similar to others that have been sorted within the same temperament; alike types should not have significant differences in their behaviour because they should possess similar traits.

6. Results and Findings

6.1 Research Study

The study conducted using the questions outlined in section 5.6 provided the data used to create the artefact. The sample used, while small, adequately indicated trends which were consistent with anonymous data obtained & reviewed, thus building confidence in this study

6.1.1 Responses to Question 1

The responses to this question all stated that extraverts would enjoy a large social gathering more than introverts would; they would feel happy and would interact and have conversations with the other people around them. Conversely, introverts would find it much more difficult to enjoy the

situation and would either seclude themselves or only communicate with people they already knew or felt comfortable around.

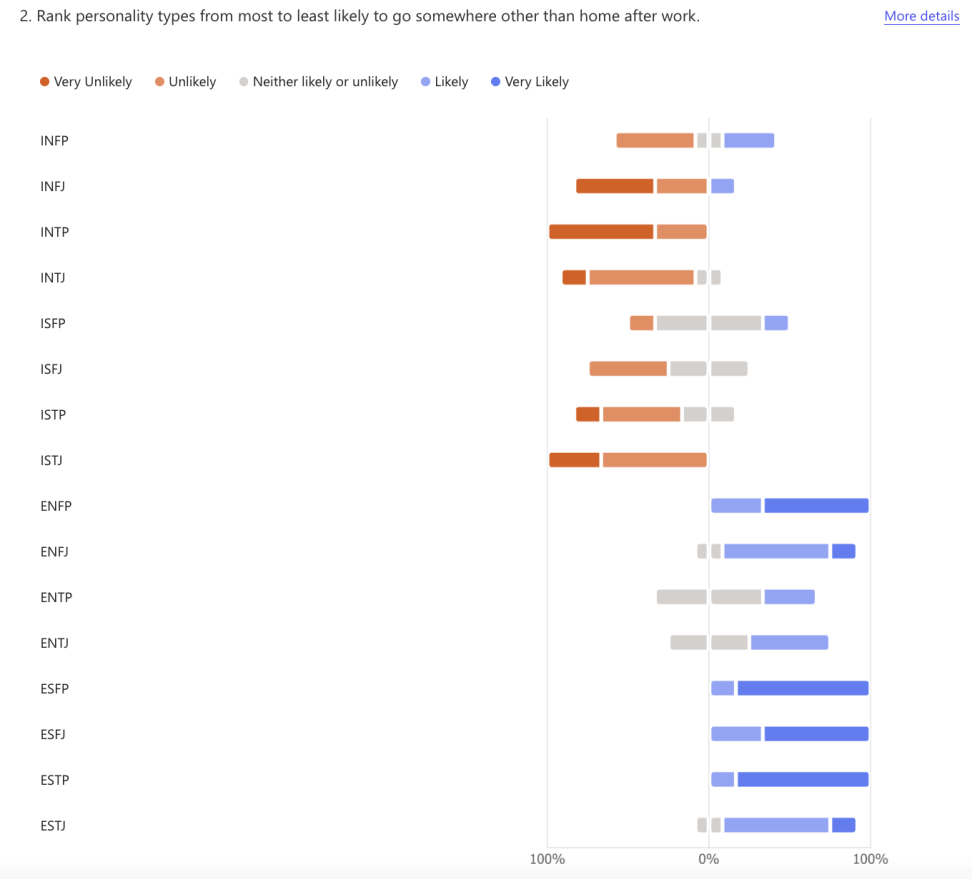
1. How would responses to a large social gathering differ between those with an I (introversion) and those with an E (extraversion)?

6 Responses

ID ↑	Name	Responses
1	anonymous	introverts would probably feel more uneasy but extraverts might like it and talk to everyone
2	anonymous	I people would probably not stay long and leave. they also wouldn't talk to many people. E would likely thrive their and enjoy the time and spend time their and talk to people
3	anonymous	E would like it a lot more, they would prefer socialising compared to I
4	anonymous	Introverts would want to communicate with people they aren't familiar with but extroverts would be willing to talk to everyone
5	anonymous	Introverts wouldn't want to interact with anyone and try to stay secluded , extroverts would socialise and make friends to keep company.
6	anonymous	E would be more happy in larger social gatherings than I and would be more open.

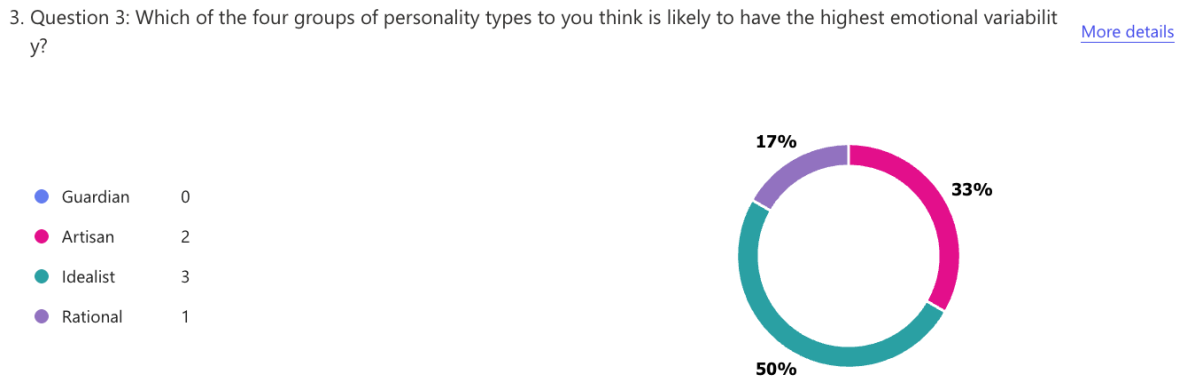
6.1.2 Responses to Question 2

There was a small amount of variation in the responses to this question, but they mostly followed a consistent pattern. Introverts, particularly those that are also thinkers instead of feelers, were generally ranked as being less likely to go somewhere else after work – for example, INTP received the most “Very Unlikely” results of any personality type. Meanwhile, extraverts were decided to have a higher chance of going somewhere else: none of the eight extraverted personality types were given a ranking of “Unlikely” or “Very Unlikely”. Another notable result is that sensing extraverts and perceiving extraverts were ranked, on average, as being more likely to go somewhere else than others, with ESFP, ESTP and ENFP receiving the highest results.



6.1.3 Responses to Question 3

The responses to this question were somewhat varied, but a consistent factor was that Guardian was never selected as the temperament with the most emotional variability. Rational was voted the second lowest with a 17% response rate, followed by Artisan at 33%, and Idealist as the highest at 50%.



6.2 The Artefact

6.2.1 Personality Definition

The sixteen different personality types exist within the project as blueprint components. A parent component named BPC_PersonalityParent provides the personalities with all the variables they need, including structs for the Current Needs and Max Needs, and enumerations variable called E_PersonalityType and E_Temperament. All specific data for the personality types is stored amongst

sixteen children of the parent component – each one named after a different persoanlity type with a matching E_PersonalityType value.

When the program is run, an actor called BP_NPCSpawner creates NPCs in the level, based on information provided by the user in an editor utility widget; there is a choice between having an even number of each personality type and having a split that reflects the distribution of the different personality types among the general population; and a choice as to whether or not colours representing the NPCs temperament are applied to their mesh. Data for the World-Accurate population spawning option was obtained through research that led to a paper written by Varasteh Nezhad et al. (2025), investigating MBTI distribution in computer industry careers. Their research involved comparing computer industry careers to the general population, and this information has been referenced in the NPC personality system as a basis for the spawning ratios of each personality type and temperament. Calculating the sum of the percentage values provided by Varasteh Nezhad et al. (2025) for each temperament provide results for their distribution that align with statistics presented by Kiersey (2004), with the Guardian temperament being the most prevalent, followed by Artisan, then Idealist, and finally Rational.

Once the NPCs have been spawned, each instance has a component applied to them to determine their personality. The code controlling the depletion of each need of the NPCs is implemented inside BPC_PersonalityParent, with the specific values of each child being applied to the calculations. If the Show Temperament Colours setting has been enabled, an overlay material corresponding to the personality type's temperament is applied to the spawned NPCs.

6.2.2 Implementation of AI

The AI functionality of the NPCs is stored within the characters themselves. Ultimately, use of Unreal Engine's built-in behaviour tree and state tree systems was decided against, and instead the AI is controlled by a state machine written in blueprints. Reasons for this decision revolve mostly around simplicity; the tasks that the NPCs must complete are very distinctly defined, and a lack of reliance on decorators or transitions allow for much quicker and easier implementation Colvin & Hayes (2010). Furthermore, a logic-based implementation enables a more direct translation of the functionality from blueprint into C++ code, should the project ever develop beyond a prototype Olejár & Szabari (2023). The state machine follows a MARPO format, with two queues being used to control the task execution: a long-term queue and a reactive queue. The long-term queue contains the default behaviour for the NPCs, which is what they will complete at times when all of their needs are satisfied and there is nothing urgent that they need to do. Conversely, the reactive queue will hold the important tasks that the character needs to complete; this queue is only activated when a stimulus triggers a response from the NPC, such as a need falling below the acceptable threshold making them need to travel to a relevant building to refill it. At the beginning of the execution of any task, the program will look at which queue needs to be executed by checking if the reactive queue currently contains any tasks; if it does it will be executed, but if it does not, the long-term queue will be executed instead. The key difference between the assignment of tasks to each queue is that, while the reactive queue will only gain tasks when something is triggered, the long-term queue will re-add a task once it has been completed, recycling them indefinitely.

6.2.3 Tasks

As a prototype for a larger system, the tasks available in the current state of the project are of a relatively simplistic nature. The long-term tasks, for example, revolve around Wander, Idle and CheckNeeds states. The Wander state is an activity for the NPCs to complete while they have nowhere the need to go. They will move to a random reachable point on the map, after which they will Idle –

the Idle state's existence is mostly for realism purposes, since it stops the NPCs from moving constantly. The CheckNeeds task fires between the others, and it looks at its owner's current need values and calculates their current percentage by comparing it with the maximum values. If the needs percentage falls below the chosen threshold of 40%, the reactive queue will be executed.

The first task that is enqueued to the reactive queue when it is triggered is QueryActors. This task gets the need that has fallen below the threshold and tries to find an actor that can refill it. The querying NPC fires a Multi-Sphere Trace by Channel at its current location that covers the map. It will then find all of the relevant actors within this sphere and test them to see if they can provide fulfilment for the low need – this is done by checking an array that exists inside the valid actors called RefillableNeedsArray. The contents of this array differ depending on the actor, but the needs that it can help fill are stored in the array using an enumeration called E_Needs. If an actor cannot fill the NPCs needs, the program moves on to the next, but if it can, the actor gets set to a variable called FoundActor and a new task called TravelToActor is enqueued. The NPC will then travel to the location of FoundActor, and, upon arrival, will call a function called StartInteractBehaviour – this includes the functionality to refill the needs value back to the maximum.

At the end of the functionality for any task in either queue, two crucial functions must be called: EndTask and CheckQueues. EndTask handles the removal of the recently completed task from the queue, and its re-addition if it is the long-term queue that is active. CheckQueues is the function that determines which queue should next be set to active, by checking the contents of the reactive queue; it also sets the current task to a variable so that it can be used in the switch case controlling the state machine.

The most complex AI behaviour in this iteration of the project is conversations. One NPC choosing to have a conversation with another initially works similarly to finding a building to which they can travel, with the same QueryActors task being executed. However, since this interaction involves two moving entities, different tasks must be performed to allow them to meet up with each other. The NPC that initiates the conversation – NPC A – will be the one who travels their conversation partner, whereas the other – NPC B – is told to wait where they are for their partner to arrive. NPC B also needs to have their flow of execution interrupted; since they are not the initiator of the interaction, its state machine does not initially know that it needs to start executing its reactive queue, so it needs to be told that its long-term execution must be paused. When NPC A arrives at NPC B, they will both execute a task called Conversation, which refills each of their social needs and grants them with an emotion; a conversation between compatible NPCs will result in both partners feeling happy, but two incompatible characters will leave the conversation angry. A Boolean named OpenToConversation controls whether an NPC can choose or be chosen to have a conversation. Though true by default, once an NPC has had a conversation, the Boolean is set to false and a timer is started; only once the timer has completed can OpenToConversation be set to true once more. The duration of the timer is dependent on the personality type of the NPC; extraverts – personality types with an E at the beginning instead of an I – will typically have a shorter timer length since they would want to converse with others more regularly than introverts. The maximum social need also affects this value further.

6.2.4 Additional Features

The project includes some features outside of the category of AI or personality types, one of which is the UI that is displayed about each NPC. Those viewing the simulation can click on any NPC in the world to show a popup above their head. This box contains information about the NPC's personality type, the task they are currently completing, their emotion, and the status of each of their needs. Also within this widget is a button containing the text "Focus Camera." Clicking this button change the

camera view to follow the selected character. The inclusion of this feature makes viewing the differences in behaviour of the NPCs more obvious, since rather than looking at each character currently in the world, the user can instead focus on just one and watch everything it does and the frequency at which its tasks are performed. The NPC can be deselected at any time by clicking on it a second time.

The project's default birds-eye camera is also an additional feature, as it exists within its own blueprint and can be moved around by the user using the keyboard. Enabling camera movement was important to allow for all aspects of the level and every NPC to always be visible.

Settings for the simulation's population spawning can be adjusted by the user with an editor utility. They can enable temperament colours to be applied as overlay materials on the NPCs, and they can choose between two different spawning distributions. The Even Population distribution spawns an equal amount of every personality type and temperament in the level. The World-Accurate Population uses real-world statistics to determine how many of each personality should spawn to reflect the average population, referencing data from Nezhad et al. (2025).

6.3 Testing

To test the behaviour of the NPCs to determine whether the objectives of the project had been met, a table was created to store data about their task execution. It tracks the number of tasks they complete, the type of task, and their emotion while completing it. The personality types that were chosen for testing were ESTJ, INFP, INTJ, and ESFP. These were selected due to each of them being part of a different temperament group, and because their composition of letters contrasts with the others, ensuring that they are not overly similar. Each NPCs behaviour was tracked for two minutes, starting from the moment the project is run.

6.3.1 Test Conditions

The level was set up to accommodate the testing by adjusting the spawn rate of the NPCs to sixteen and selecting the Even Population setting. This ensured that each personality type was only represented once, which was crucial to obtaining as much unique data as possible, since there was a smaller chance of NPCs interacting with the same personality types repeatedly. Furthermore, a limited number of characters present in the world reduces the chance of them bumping into one another and slowing down their task completion.

In its finished state, the NPC spawner will create the NPCs to have their needs filled at a random percentage. This system allows for behaviour that appears more natural, particularly when multiple NPCs with the same personality type are present; all characters starting with their needs at their maximum values means that multiple NPCs will need to refill them at the same time, resulting in a herd-like movement as they fall beneath the threshold. However, for testing and observing their behaviour, constant conditions are necessary to obtain fair and accurate results. Therefore, the randomised percentage system was disconnected for the duration of the testing phase. Further adjustments were made to the NPCs by reducing the duration of the looping timer that controls the reduction of their needs; this was done to ensure that the needs would be able to fall below the threshold in the two-minute timeframe.

6.3.2 Testing and Results

Testing involved following each of these types for two minutes each and tracking all the changes to their activity text in their information widget. This process was then repeated three times for each personality type to obtain fair results.

Personality Type	Temperament	Test 1				Test 2				Test 3			
		Number of Tasks	Task	Emotion	Lowest need (if emotion is Sad)	Number of Tasks	Task	Emotion	Lowest need (if emotion is Sad)	Number of Tasks	Task	Emotion	Lowest need (if emotion is Sad)
ESTJ	Guardian	1	Wander around	Fine		1	Wander aroun	Fine		1	Wandering around	Fine	
		2	Going to talk to INFJ	Fine		2	Going to talk to INFP	Fine		2	Waiting to have conversation with ENTJ	Fine	
		3	Talking to INFJ	Angry		3	Talking to INFP	Angry		3	Talking to ENTJ	Angry	
		4	Going to talk to INFP	Angry		4	Wandering around	Angry		4	Travelling to park	Angry	
		5	Talking to INFP	Angry		5	Travelling to park	Angry		5	Waiting to have conversation with ISTJ	Happy	
		6	Wandering around	Angry		6	Wandering around	Happy		6	Talking to ISTJ	Happy	
		7	Travelling to park	Angry		7	Going to talk to ENFP	Happy		7	Travelling to park	Sad	Fun, relaxation
		8	Wandering around	Fine		8	Talking to ENFP	Angry		8	Wandering around	Happy	
		9	Going to talk to ENTJ	Fine		9	Wandering around	Angry		9	Going to talk to ENTP	Fine	
		10	Talking to ENTJ	Angry		10	Travelling to disco	Sad	Fun	10	Talking to ENTP	Angry	
		11	Wandering around	Angry		11	Wandering around	Angry		11	Travelling to park	Angry	
		12	Travelling to disco	Sad	Fun	12	Travelling to park	Angry		12	Travelling to disco	Sad	Fun
		13	Wandering around	Angry		13	Waiting to talk to INTP	Happy		13	Wandering around	Fine	
		14	Travelling to park	Happy		14	Talking to INTP	Angry		14	Waiting to have conversation with ENTJ	Fine	
		15	Waiting to talk to INTJ	Fine		15	Travelling to park	Happy		15	Talking to ENTJ	Angry	
		16	Talking to INTJ	Angry		16	Wandering around	Happy		16	Wandering around	Angry	
		17	Wandering around	Angry		17	Going to talk to ENTJ	Happy		17	Travelling to park	Angry	
		18	Travelling to park	Happy		18	Talking to ENTJ	Angry		18	Wandering around	Happy	
		19	Wandering around	Fine		19	Travelling to disco	Sad	Fun	19	Going to talk to ESTP	Happy	
		20	Going to talk to ESFP	Fine		20	Wandering around	Angry		20	Talking to ESTP	Happy	
		21	Talking to ESFP	Happy		21	Travelling to park	Angry		21	Wandering around	Fine	
		22	Wandering around	Happy		22	Wandering around	Happy		22	Travelling to disco	Sad	Fun
		23	Travelling to park	Happy		23	Going to talk to ESFP	Happy		23	Wandering around	Fine	
		24	Wandering around	Fine		24	Talking to ESFP	Happy		24	Travelling to library	Sad	Education, relaxation
		25	Travelling to park	Sad		25	Wandering around	Happy		25	Wandering around	Fine	
		26	Wandering around	Fine		26				26	Travewilling to disco	Sad	Fun, social
		27	Going to talk to INFP	Fine		27				27			
		28	Talking to INFP	Angry		28				28			
		29	Wandering around	Angry		29				29			
INFP	Idealist	1	Wandering around	Fine		1	Wandering around	Fine		1	Wandering around	Fine	
		2	Waiting to have conversation with ENTP	Fine		2	Waiting to have conver	Fine		2	Waiting to have conversation with ENTJ	Fine	
		3	Talking to ENTP	Happy		3	Talking to ISTJ	Angry		3	Talking to ENTJ	Happy	
		4	Wandering around	Happy		4	Wandering around	Angry		4	Travelling to disco	Sad	Fun
		5	Travelling to disco	Happy		5	Travelling to disco	Angry		5	Wandering around	Happy	
		6	Waiting to have conversation with ENTJ	Fine		6	Wandering around	Happy		6	Travelling to school	Sad	Education
		7	Talking to ENTJ	Happy		7	Travelling to disco	Sad	Fun, Education, Relaxation	7	Wandering around	Fine	
		8	Wandering around	Happy		8	Wandering around	Fine		8	Waiting to have conversation with ESFP	Fine	
		9	Travelling to park	Sad		9	Waiting to talk to ISFJ	Fine		9	Talking to ESFP	Angry	
		10	Wandering around	Happy		10	Talking to ISFJ	Angry					
		11	Travelling to library	Sad		11	Travelling to disco	Sad	Fun, Education, Relaxation				
						12	Travelling to Library	sad	Education, relaxation				
INTJ	Rational	1	Wandering around	Fine		1	Wandering around	Fine		1	Wandering around	Fine	
		2	Going to talk to ESFP	Fine		2	Going to talk to INFJ	Fine		2	Waiiting to have conversation with ISFJ	Fine	
		3	Talking to ESFP	Angry		3	Talking to INFJ	happy		3	Talking to ISFJ	Angry	
		4	Wandering around	Angry		4	Wandering around	Happy		4	Wandering around	Angry	
		5	Travelling to library	Angry		5	Travelling to library	Happy		5	Travelling to library	Angry	
		6	Wandering around	Happy		6	Wandering around	Happy		6	Wandering around	Happy	
		7	Going to talk to ESTJ	Happy		7	Travelling to Library	Happy		7	Travelling to library	Sad	Education
		8	Talking to ESTJ	Angry		8	Wandering around	Happy		8	Wandering around	Happy	
		9	Wandering around	Angry		9	Travelling to park	Happy		9	Travelling to library	Happy	
		10	Travelling to library	Sad	Education	10	Wandering around	Fine		10	Wandering around	Happy	
		11	Wandering around	Angry		11	Travelling to school	Sad	Education	11	Waiting to have conversation with ENFP	Fine	
		12	Travelling to library	Fine		12	Wandering around	Happy		12	Talking to ENFP	Happy	
		13	Going to talk to ESFJ	Fine		13	Going to talk to ESFP	Happy		13	Travelling to school	Sad	Education
		14	Travelling to disco	Sad	Fun	14	Talking to ESFP	Angry		14	Travelling to disco	Sad	Fun
		15				15	Travelling to library	Angry					
		16				16	Travelling to library	Sad	Relaxation				
ESFP	Artisan	1	Wandering around	Fine		1	Wandering around	Fine		1	Wandering around	Fine	
		2	Going to talk to ENTP	Fine		2	Going to talk to ISFJ	Fine		2	Going to talk to ISFP	Fine	
		3	Talking to ENTP	Angry		3	Talking to ISFJ	Happy		3	Talking to ISFP	Happy	
		4	Wandering around	Angry		4	Wandering around	Happy		4	Going to talk to ENFJ	Happy	
		5	Travelling to cafe	Happy		5	Travelling to school	Sad	Education	5	Talking to ENFJ	Angry	
		6	Wandering around	Happy		6	Wandering around	Happy		6	Wandering around	Angry	
		7	going to talk to ENTJ	Happy		7	Going to talk to ESTP	Happy		7	Travelling to school	Sad	Education, fun
		8	Talking to ENTJ	Angry		8	Talking to ESTP	Happy		8	Travelling to disco	Sad	Fun
		9	Wandering around	Angry		9	Wandering around	Happy		9	Waiting to have conversation with INFJ	Fine	
		10	Travelling to cafe	Angry		10	Travelling to disco	Sad	Fun	10	Talking to INFJ	Angry	
		11	Travelling to school	Sad	Education	11	Travelling to school	Sad	Education, social	11	Wandering around	Angry	
		12	Wandering around	Happy		12	Wandering around	Happy		12	Travelling to school	Sad	Education
		13	Going to talk to ISFJ	Happy		13	Travelling to cafe	Sad	Relaxation	13	Going to talk to INTJ	Fine	
		14	Talking to ISFJ	Happy		14	Wandering around	Fine		14	Talking to INTJ	Angry	
		15	Wandering around	Happy		15	Going to talk to ISTP	Fine		15	Wandering around	Angry	
		16	Travelling to cafe	Happy		16	Talking to ISTP	Happy		16	Travelling to cafe	Angry	
		17	Wandering around	Happy		17	Wandering around	Happy		17	Wandering around	Happy	
		18	Travelling to disco	Sad	Fun, social	18	Travelling to school	Sad	Education	18	Travelling to block of flats	Sad	Relaxation, social
		19	Wandering around	Happy		19	Wandering around	Fine		19	Going to talk to ESTP	Fine	
		20	Waiting to have conversation with ESTJ	Happy		20	Travelling to disco	Sad	Fun	20	Talking to ESTP	Happy	
		21	Talking to ESTJ	Happy		21	Travelling to block of fl	Sad	Social	21			
		22	Wandering around	Happy		22				22			
		23	Travelling to school	Sad	Education	23				23			
		24	Waiting to have conversation with ESTJ	Fine		24				24			
		25	Talking to ESTJ	Happy		25				25			
		26	Wandering around	Happy		26				26			
		27	Travelling to Block of Flats	Sad	Relaxation, social	27				27			

7. Discussion and Analysis

7.1 Showings

7.1.1 Study

The participants' responses to the questionnaire were overall very consistent with one another: answers typically aligned with the definitions outlined by Bharadwaj (2018), particularly regarding how those of varying personality types would respond to certain scenarios. This is exhibited most strongly with the responses to Question 2; though responses among participants varied, there is a general pattern spotted in the order in which the personality types have been ranked that correspond with Neal and Neal (2009)'s claims about the differences in sociability and relaxation needs. Moreover, Kiersey (2004)'s interpretations of the personality types that formed KTS are also supported; Guardians were typically ranked higher in likelihood of going out after work, whereas Idealists were ranked lower, indicating the focus each temperament places on relaxation. This question provided

the most insightful information overall as the responses involved every personality type. As described in section 6.1.2, introverts – in particular, thinker introverts – were decided to be less likely to go somewhere other than home after work, and sensing extraverts and perceiving extraverts were the most likely. The information gathered from this question helped build each personality type's social need further, but also aided the fun and relaxation needs; those more likely to go out can be inferred as holding fun as a higher priority. Furthermore, those who are less likely to go somewhere else are likely to have a higher relaxation need, due to their preference of going home at the end of the day instead of completing more activities.

Question 1, which asks about the differences in reactions between extraverts and introverts in a large social gathering, all stated that extraverts would enjoy it more, and would be more likely to feel happy and have conversations with others. These responses indicated that extraverts would likely have a higher social need than introverts and would require less of a cooldown between conversations. As such, this data directly influences the strengths of the social and conversational characteristics of all personality types.

Question 3 had the most variety of responses, but Guardians never being chosen as the type with the highest emotional variability aligns with definitions presented by Kiersey (2004) that describe Guardians as the most stable and structured temperament.

7.1.2 Testing

The data collected from viewing the NPC's activities during a time span of two minutes produced some patterns in results. The sociability and conversation of the different subjects stood out as the most interesting. The two extraverted personalities, ESTJ and ESFP, were involved in more conversations than the others, with an average of five conversations in two minutes, compared to an average of two for the introverted personality types, INFP and INTJ, indicating an increased desire for social interaction. Furthermore, the extraverted personalities were far more likely to initiate conversations than the introverted; in the collected results, INFP did not initiate any conversation, with every interaction they were a part of being instigated by the partner, while 73% of ESTJ's conversations were instigated by itself.

The emotions that occurred as results of conversations also followed a pattern, with Guardians and Artisans getting along better with each other than with Rationals and Idealists. Conversations between two incompatible types resulted in an angry emotion, while compatible types resulted in happiness.

Locations visited by the NPCs also provide insight into which of their needs may be the strongest. Anger made the NPCs travel to their favourite location to make themselves feel better. The building they choose as their favourite is generated using a function that takes inti account data about their personality type, such as the needs they find most important. The locations they travel to grant information about their personalities. The Rational, INTJ, travels to the library most often. Since the library refills the education need, it is clear that they prioritise education highly; however, their choice of the library over the school indicates that their social need may be of lower importance to them, so they choose to go there less often to ignore that need. This decision aligns with explanations provided by Bharadwaj about INTJ and other introverted personalities in regard to their preference of self-isolation over socialising, and completing tasks independently. Meanwhile, the Guardian, ESTJ, frequently visits the park, with 60% of its travelling tasks leading there. The park grants fulfilment of the relaxation and fun needs, suggesting that these may be important to the ESTJ. However, 88% of its travelling activities based on feeling sad, caused by a low need, are to refill the fun need, implying that this is a need that declines rapidly, and therefore is more of a priority. The Artisan, ESFP, has the most variation in its travel destinations compared to the other types that were tested, suggesting that

their needs may be quite similar in intensity. From their higher number of task changes, it can be inferred that these similar intensities are quite high, meaning that all of them are important to the ESFP; if they were less important, there would have been fewer destinations visited, as they would not have had to refill any needs very often. ESFPs are defined by Bharadwaj (2018) as being spontaneous and vibrant, and the actions of the NPC in the level successfully convey these ideas. These results indicate that the personality typing resulted in behavioural differences that were readily observable.

7.3 Adequacy of Methodology

7.3.1 Study

The questions asked to participants of the study were sufficient in gathering information to aid the artefact. Using the responses, values could be considered that provided a basis for the actions of the NPCs in the artefact, such as the frequency at which they will complete tasks, and which locations they will prefer over others. The utilisation of objective opinions of a range of people allowed for an average result to be taken that created a more defined and dependable outcome. Including a question allowing participants to rank each personality type according to the provided scenario proved to be an effective method for gathering information about their habits, and ensured that every type was represented; less specific questions allow for more vague responses, and participants may only answer using personality types with which they are familiar, potentially leading to gaps in research.

Though the influence that the study had on the development of the personalities was good, the questionnaire itself was somewhat limited. The small number of questions, in addition to their more abstract nature, meant there was a finite amount of information could be gathered; questions allowing for an increase of unique responses would be helpful to create further distinctions between the personality types.

7.3.2 Testing

The planned testing methodology was followed closely, and the outcome was a table of results that aligned well with the research conducted into the different personality types, and with the objectives of the project – particularly Objective 1, "t**o create NPCs with substantial observable differences in behaviour that make them feel distinct from one another". The characteristics of each typed that were defined by** Katharine Cook Briggs and Isabel Briggs Myers, and discussed further by Bharadwaj (2018) were represented successfully among the NPCs, especially in regard to sociability, and create noticeable differences in their behaviours that could allow an observer to deduce their personality type. Obtaining this data, analysing the results, and ultimately being able to consider Objective 1 successful proves there was a level of adequacy in the testing methodology. However, the process could still be improved upon; the biggest drawback of the utilised methodology is the sample size, since only four of the sixteen personality types were tested. Although the chosen types were fairly distributed among the four temperaments, collecting data for every available archetype could provide more thorough results.

7.4 Criticisms

Though results were obtained that align with literature and support the aims of the project, the small number of tasks available in the current iteration of the project could hinder the accuracy of the NPCs, as fewer unique behaviours mean that the characteristics that make up personalities are limited in how they can be represented. Additionally, the current setup of the state machine in Blueprints could easily get convoluted, potentially impeding future progress or developments, due the messy and disorganised execution lines and pins.

7.5 Features that Affected Results

As discussed in section 7.3.1, the questionnaire presented to study participants was limited in the information that could be collected. Results appearing to show unjustified similarities between personality types could be attributed to the lack of data collection in this phase of the project, since a greater quantity of responses would have allowed for more nuance between the behaviour of different NPCs.

The artefact itself was held back by complications in the development process. Bugs and other issues in the process of creating the blueprints to control the state machine and the decision-making meant that there was not as much time to develop different kinds of tasks as originally hoped. Though the core tasks, including travelling to destinations based on low needs, and conversing with other NPCs, were successfully implemented, further activities, particularly as additions to the long-term queue, would have been beneficial in more easily identifying the different personalities being represented. As such, the results collected and recorded are quite repetitive, with distinctions between the different types' behaviours not always being immediately apparent.

8. Conclusion

To conclude upon this work, it is reasonable to consider that the project has adequately achieved its objectives and therefore can be determined to be a success. Though areas of both the functionality of the artefact and the presentation of the characteristics of the personality types could be improved upon, the NPC Personality System serves as an example of how non-player characters in video games can be provided with unique traits that allow for dynamic behaviour and the enhancement of world-building.

The aim of the project was to develop a system that would help the realism of NPCs in video games. Instead of repetitive and formulaic behaviour, the actions of the NPCs in this system would be unique depending on the personality type they had been assigned. The personalities available are based on the different outcomes of the Myers-Briggs Type Indicator, a personality model that categorises the nature of any person into one of sixteen different personality types, dependent on different traits that they exhibit, such as sociability and decisiveness. Personality types were further broken down into four groups of four, using Kiersey's Temperament Sorter as a reference. The characteristics described by these personality models have been used to influence the values of variables that control the decision-making and triggers of the AI agents in the world; for example, determining the strength of social, fun, education and relaxation needs, and the rate at which each needs refilling. The system has been prototyped in Unreal Engine 5.6 using Blueprints, and the AI system is controlled using a Finite State Machine following the principles of MARPO. Results of the system to determine its success were based on testing performed on four personality types, one of each temperament, and observing their behaviour multiple times throughout a two-minute duration.

Results of the testing revealed patterns in the behaviours of four chosen personality types. Most notably, the differences in sociability between the introverted and extraverted NPCs are stark, with extraverted characters initiating and partaking in conversations significantly more often than introverted, proving a noticeable distinction between personality types. Visitation of locations in the world is also indicative of differences in personality types, with the frequency of their visits being dependent on each type's unique needs values and deterioration rate. Furthermore, the locations they choose to visit to satisfy these needs also differ between personality types and their specific preferences; for example, an NPC with a strong education need but a weak social need would choose to visit the library instead of the school because, while they both provide education fulfilment, the

school provides social as well, which the NPC does not care about. These results were gathered by focusing the camera on an NPC with a desired personality type and tracking every change in task or emotion, and, after all required repetitions, the changes were analysed to find consistencies. Overall, the results were very consistent with one another, suggesting a strong reliability of the system, while still avoiding repetition; none of the tested executions were identical, implying that this system achieved its goal of creating dynamic behaviour. A significant part of this success is the MARPO approach to the AI, which allows for the default flow of execution contained within the long-term queue to be interrupted at any point to complete a task in the reactive queue that had been triggered by a stimulus. By doing this, the behaviour of the characters appears more lifelike, since they will actively respond to the world and their own needs instead of completing an automatic sequence of events.

However, limitations of the methodology have left potential gaps in confirming the success of the system; it could be argued that the small sample size, in addition to the lack of external test participants, could produce results that are unreliable or not representative of the system and personality types as a whole.

Further criticisms of the project could come in the form of the use of the MBTI personality model; academics have criticised it for its accuracy due to poor test-retest reliability (Pittinger 2005). However, despite its limitations, MBTI has merit in its simplicity and its clear distinction of sixteen different archetypes that make it ideal for the basis of developing a personality system for video games; distinguishable personality types with clearly defined traits can be easily translated into the numerical values that create the different characteristics of the characters. Furthermore, its categorical structure allows for direct conversion of psychological characteristics into a technical implementation, allowing for easy influence of decisions and task-selection within the FSM (Lepri & Lepri, 2018). Though not the trait-based model with the most depth, its translation capabilities make it a good foundation for developing a personality-based behaviour system.

Developing the system using a finite state machine could also be seen as an area on which development could be improved, since behaviour trees are more suitable for large-scale AI systems. However, since the current state of the artefact is a prototype, its scale is not large enough to warrant the use of behaviour trees; the simplicity and readability of FSMs is more beneficial to create the foundations of a project to ensure the viability, while allowing for a simple translation into a behaviour tree for future development.

The completion of this project lends itself to game design and simulations by proving the feasibility of including NPCs that behave in unique ways due to having distinct personalities. The artefact and its test results prove that observable differences can be created, and that the activities that NPCs complete and their frequency of execution align effectively with the sixteen MBTI archetypes. In doing so, it has verified its own use for simulation and open-world games; the artefact in its current form is its own micro-society, with its various types of NPCs completing their tasks in ways so different that similarities and repetition among them not being easily detectable. As such, its addition to any open world would immediately create a dynamic and more realistic population. Furthermore, the setup of the personality types as Blueprint components that can be added to any actor in an Unreal Engine project mean that the personality system can be easily implemented in a wide range of scenarios. Though further abstraction could be undertaken to simplify the addition of the system to a project more, its current status is a strong foundation for a system that could be added to any game or simulation.

A simple advancement of the system would be to add more tasks for the NPCs to complete; wider variety of activities reduce repetition and enhance realism, as well as providing more ways to differentiate between personality types and temperaments. Further developments of the technical aspect of the project could include migrating the AI system to a behaviour tree to allow for future scalability, and by refining the definition of traits and characteristics of the personality types by constructing them using a mathematical approach that uses data about their MBTI attributes to calculate values used to influence their decisions. Besides technical advancements, the personality types, and the project as a whole, could be improved by using a more developed testing methodology, involving every personality type instead of four, and by including external participants to partake in the process in addition to the primary researcher. The inclusion of all of these advancements would elevate the project father and increase its overall quality.

Overall, the completion of the NPC Personality System leads to the conclusion that the inclusion of personality to non-player characters is fundamental to creating a realistic collection of behaviours that distinguish different characters and making them unique from one another. The creation of the artefact and the patterns and differences identified from the results of testing the system prove how the use of psychological models can inform decision-making agents in video games and make them appear more human-like. Though small in its current form, the proven feasibility of personality-based characters is promising for the development of realistic and immersive world-building in simulations and video games.

9. Recommendations

9.1 Improvements to Research Methodology

To create the most accurate representation of personalities in a project such as this one, very thorough research would be required to discover the specific nuances of each type. Though investigation through literature into the composition of each type can provide a good understanding of the differences between the types at a factual level, the best way to understand how they present themselves in individuals would be to conduct a survey that asks participants their personality type and questions them on how they would act in different scenarios. A large sample of participants would be required; at an absolute minimum, the researcher would require sixteen participants, all of a different personality type, in order to have information about every possible personality configuration. However, a number this small would not provide reliable data, as it does not account for any possible anomalies; for instance, a participant may be categorised into one personality type, but the strength of their characterises could make them very close to a different type, making their assigned type weaker. In this case, an individual with a weaker personality type may behave differently to someone of the same type who had a stronger result. Therefore, a large sample size is required to allow for the researcher to be able to calculate an average that best represents the behaviours of each type. A survey of this nature, however, comes with difficulties in how it can be conducted – most significantly in terms of ethical and privacy issues. Data about a participant's personality and psychological characteristics could be considered sensitive information, and therefore the researcher would need to create a thorough consent form that informs participants of how their information is going to be used. Nonetheless, the results of a successfully conducted study of this manner would be invaluable to understanding the actions of each of the different personality types.

An additional survey could also be conducted using external participants that questions them on the immersion being created by the NPCs' behaviour. A questionnaire could be provided alongside a project including some NPCs that use the personality system and some that do not. The questions could ask the participants if they find themselves drawn to the behaviours on display from the NPCs with personalities in comparison to the others. The results of this survey would further indicate the overall success of the project, as it would provide information on how the inclusion of the personalities enhances the world-building.

9.2 Improvements to Definition of Personality Types

In the system's current state, the sixteen different personality types are defined rigidly, with their maximum needs values being set to a specific float value based on psychological research into their traits. This form of implementation successfully forms the types by guaranteeing that every need will match how an individual of a given personality type would feel about the distinct categories. A potentially more effective system, however, would be to determine the maximum need values using a mathematical approach. With each personality type being made up of a different combination of letters, a system could be written that assigns each letter a numeric value that would be combined with the others to calculate an overall "personality score." This score could then be used to determine how strongly an NPC should feel towards certain needs or activities; for example, a personality type that values education is ENTP. The formula would be created in such a way that by finding the sum of these for letters, a value would be produced that would indicate that they have a high interest in education, whereas an NPC less interested – such as ESTJ – would generate a lower score. Since the maximum needs values affect the tasks that the NPCs complete, creating the value in this manner would impact their general behaviour. While more complex an implementation than simply choosing a float to use as the maximum value, it is likely that this approach would provide a higher degree of accuracy; the values are no longer chosen based on opinions of the researcher, minimising the possibility of human error, but rather the results of calculations.

9.3 Improvements to Implementation of AI

In developing the project up to its current conditions, the use of a state machine is justified and has worked effectively. However, if the project were to be developed further and the quantity of tasks became much higher, a different form of AI implementation, such as behaviour trees, might be considered. Supported by Iovino et al. (2025), a large AI decision-making system can become unsuitable for a state machine due to the number of required transitions making it overly complicated. Human behaviour contains many nuances, and, as such, thousands of different tasks could be implemented. If the behaviour system were to grow reach this size, a behaviour tree could become more appropriate for its modular nature (Colledanchise & Ögren 2018). To enhance the scale further, a large behaviour tree could contain a series of subtrees, improving the modularity and readability; reactive behaviour trees could also be revisited to preserve the MARPO structure while accommodating for expandability (Roberts, 2024).

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