PONTiFF: PersONaliTy Framework For Companion Characters

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Abstract

Personality has been a key feature in the creation of companion characters for digital games. These characters cooperate with the player to overcome obstacles and progress through the game. In this work, we present a generic framework and a personality model inspired by Cloninger's psychobiological model of Temperament and Character to convey a companion character's personality in the context of the cooperation between the companion character and the player. Our framework is comprised of the character's personality, a decision system based on the character's personality, and a tag system to keep track of the character's experience, knowledge, objectives, etc. We conducted a two-stage experiment to better understand (1) if the character's graphical design has an influence on personality reporting and (2) if the companion's personality conveyed by our model is adequately perceived by the player through interaction. Our results suggest that (1) in-game behaviour is more important than first impressions induced by the character's design and that (2) two of our traits (Harm Avoidance and Cooperativeness) were easily understood by the participants.

Author Keywords: Companion Characters, Synthetic Characters, Personality, Digital Games.

Introduction

Personality has been a key feature in the creation of characters in videogames, and has been applied in several different ways through different games. For example, *The Sims* Series[1] have exposed their personality system for their *Sims* (definition of the characters in the game) to allow players to create diverse characters. The recent iteration of the game "The Sims 4", uses traits and aspirations to define the characters' personality, which influences their behaviour. Yet, personality in videogames is not limited to interactions with the player, but also via character animations. A common approach in first person games is to leave the players' character in a blank state to allow the players to express their personality. However in Overwatch[2], a multiplayer First Person Shooter (FPS), each character (named as hero in the game) stance, design and body motions are specifically crafted to each hero, to convey the character's personality[10].

In this work, we focus on companion characters. Companion characters are Non-Player Character (NPC)[3], that will cooperate with the player throughout the game to surpass upcoming obstacles in order to progress. For example, in The Last Guardian[4] the player must interact with Trico to solve puzzles(e.g. the player by throwing barrels with food for Trico can make the creature move to a certain location, then climb the creature to reach a certain place). Most games rely on cutscenes to express the characters' personality, rather than expressing it via in-game behaviour. So, we intend to define a personality model for companion characters in videogames. Alongside this personality model, we intend to create a personality framework for companion characters (PONTiFF) for different videogame genres. We set as guidelines that both the personality trait model and PONTiFF, to be simple to implement and to understand by game designers and game developers. This document is organized in the following order: we will start by presenting three personality models from psychology literature, and discuss which we selected as a basis for our personality model for companion characters; review works that use personality in synthetic and companion characters, in both the academic and gaming setting; introduce our personality model and framework for companion characters; disclose our evaluation methodology, and analyse the data we obtained from our tests; and conclude the work with contributions made by this work and guidelines for possible future work.

Personality Models

To guide the development of our personality model for companion characters, we researched different personality models. The two most common personality models in the psychology literature are: the Five Factor Model (FFM) which has seen a substantial use on the implementation of computational models for synthetic characters, and the Myers-Briggs Type Indicator (MBTI) which has been used in a wide range of areas of application. Although across our research, we found another personality model, Cloninger's psychobiological model of temperament and

[1] https://www.thesims.com/en_GB/

[2] https://playoverwatch.com/en-gb/

[3] NPC characters are not controlled by the player, but often controlled by scripts or an Artificial Intelligence algorithm.

[4] https://www.playstation.com/en-us/games/the-last-guardian-ps4/

character, which we found to be in more agreement with the focus of this work.

Five Factor Model (Model)

The FFM is a personality trait model that defines five broad domains of traits. Each trait has a scale, which measures different behaviours. The traits defined by FFM are the following [12]:

Openness to experience a person evaluated with high openness to experience is intellectually curious, always seeking novelty and complex experiences.

Conscientiousness a conscientiousness person is methodical and self-disciplined.

Extraversion an extraverted person is energetic and social, always seeking interaction with others.

Agreeableness an agreeable person is straightforward and altruistic. It is capable of trusting in others and expressing altruistic behaviours.

Neuroticism a neurotic person is emotionally unstable, with the tendency to experience negative emotions, such as anxiety and depression.

Myers-Briggs Type Indicator (MBTI)

MBTI was initially developed by Isabel Briggs Myers and Katherine Briggs in 1942, based on the theory of psychological types by Carl Gustav Jung. In an effort to make Carl Gustav Jung theory of psychological types available to the masses[9], Isabel Briggs Myers and Katherine Briggs developed 4 pairs of dimensions, with a total of 16 combinations of preferences:

Extraversion (E) vs Introversion (I) represents the preference on the focus of the outer or inner world. An extroverted person is a person that enjoys being active and being around other people. Whereas, an introverted person likes to spend time in their inner world and reflect on ideas inside their head;

Sensing (S) vs Intuition (N) represents the preference on focusing on information coming from their senses or through the search of patterns on information. A sensing person prefers using "common sense" to tackle a problem. An intuitive person prefers to dissolve the information in patterns and connections to tackle the problem;

Thinking (T) vs Feeling (F) represents the preference when deciding, whether facts or personal concerns have more weight than the other. A thinking person will put more weight into facts when deciding, while a feeling person will put more weight on personal concerns;

Judging (J) vs Perceiving (P) represents the what type of lifestyle a person prefers, and transmits to others. A judging person tends to be orderly and organized. A perceiving person tend to be someone spontaneous and open-minded.

Cloninger's psychobiological model of temperament and character

In *"A unified biosocial theory of personality and its role in the development of anxiety states"*[2], Cloninger first hypothesized three dimensions (Novelty Seeking, Reward Dependence, and Harm Avoidance) which are "genetically independent and that have predictable patterns of interaction in their adaptive responses to specific classes and environmental stimuli"[1]. Later, a fourth temperament trait rose, persistence, "originally thought to be a component of reward dependence"[3]. Along the 4 temperament traits, Cloninger in *"A psychobiological model of temperament and character"*[3] also described three dimension of character. These dimensions are related with the concept of character development, defined by Cloninger as "insight learning[5] or reorganization of self-concepts[6]"[3]. The 4 dimension of temperament and the 3 dimensions of character are the following[1, 3, 11]:

Novelty Seeking This temperament is responsible for frequent search of adventure, and seeking potential rewards. Simultaneously, trying to avoid monotony and possible punishment. Novelty Seeking can also result in quick tempered behaviour, acting on hunches for those who score above average levels. Whereas, people who score lower than average levels of novelty seeking are slowly engaged to new activities and interests. The people who score lower than average often think before acting.

Reward Dependence This temperament is responsible for the response to rewards and succorance[7]. People who score above average levels of reward dependence are dependent to emotional support and seek intimacy with others. On the contrast, people with score lower than average of reward dependence tend to isolate from others, and present cynical and insensitive behaviour. The people with score lower than average have better response to practical rewards, such as money.

Harm Avoidance This temperament causes inhibition of exploration of unknown places or uncertain situations, and passive avoidance of punishment and non-reward. People with high harm avoidance are almost always fearful and insecure. On the opposite side, people with low score in harm avoidance may act carelessly, independently if faced with unknown situations or situations that may result in injury. People with low score are seen as confident and optimistic with the ability of rapid adaptation to changes.

Persistence This temperament is responsible for the determination and perseverance despite the frustration and the fatigue a person might be experiencing. A person with

[5] Insight learning can be seen as the mechanism that develops new responses caused by conceptual reorganization.

[6] Self-concepts are "distinguished according to the extent to which a person identifies the self as an autonomous individual, an integral part of humanity, an integral part of the unity of all things"[3].

[7] the act of seeking out affectionate care and social support

higher than average score in persistence is seen as ambitious, an overachiever, and a perfectionist. Although people with score below average, lack ambition and will easily abandon a task when faced with fatigue and frustration.

Self-Directedness This temperament refers to willpower and self-determination of a person. A person that scores above average in this trait are seen as having good self-esteem, responsibility, capable of defining clear long term goals and values, and capable of showing initiative when faced with an challenge. Whereas, people with score lower than average are incapable of assuming their own mistakes, and incapable to define clear goals and values.

Cooperativeness This temperament determines whether a person is capable of acceptance, cooperation and identification with others. An above than average score on this trait results in: altruistic behaviour, empathy, and an attitude of acceptance towards others. A person that scores lower than average is seen as: intolerant, uncaring, revengeful, and selfish.

Self-Transcendence This temperament is related with spirituality and the ability of feeling that the person is a part of something larger than herself. This trait determines whether the person is capable of accepting and identify herself as an essential part of the whole. A person with a higher than average score is capable of experiencing "transpersonal" experiences and accept unavoidable events.

For this work, we opted for Cloninger's psychobiological model of temperament and character as a guideline for our work, because the traits presented by this model are easier to be mapped to game concepts than the ones presented by MBTI and FFM. One of the most common challenges that a player has to face in a game is combat, but the FFM traits do not suggest any clear connection to help us link combat to FFM. This is made evident when we see that Harm Avoidance is correlated with multiple small order traits from Neuroticsm, Extraversion and Openness to Experience traits of the FFM[4]. We also excluded MBTI because of how hard it is to relate game concepts. For example, when designing a companion character, it is important to define how much cooperative the character will be towards the player. MBTI does not define a specific trait for this behaviour, unlike MBTI, Cloninger's psychobiological model of temperament and character defines the cooperativeness in one trait (Cooperativeness). As matter of fact, in a study done by K. J. Swope et al.[13], the authors concluded that the combination of extraversion and feeling types were more cooperative.

Personality in synthetic and companion characters

Personality has been used in multiple ways to influence a character's behaviour. For example, Doce et al.[5] used FFM to influence four cognitive/behavioural processes (i.e: "emotions, coping behaviour, means-ends reasoning and bodily expression") to achieve distinguishable characters. Egges et al.[6] uses the OCEAN model (FFM) "as a selection criterion that indicates what and how many goals, structures and attitudes" from the Ortony, Clore and Collins (OCC) model that "fit with the personality". Bosch et al.[15] uses the character's personality to conduct dialogue which reflects the character's personality, via FFM's Extraversion and Agreeableness traits. Filipe et al. [8] used the Thomas' Dual-Concern Conflict model to allow their character to express its personality via cooperative behaviours. Thomas' Dual-Concern Conflict model defines two dimensional axes, assertiveness and cooperativeness[14], which are used to define the characters' personality. PERSEED[7] is a personality model for virtual characters that utilises socio-cognitive theories. According to Caroline Faur et al.[7], the socio-cognitive approach to personality takes into account the context of the situation. Arguing that personality trait models hide intra-individual differences. But, as pointed out by Carouline Faur et al.[7], "modeling personality is made more complex because we move from five traits to an intricacy of structures and processes in an interplay"[7].

Since, our work focus on creating a personality model and a generic framework for companion characters, as such we chose a different approach. Because we want our work to be easily understood by game developers, we decided that our characters' personality will directly modify the companion's behaviour. This means that any change made to a character's personality may result on a different behaviour from the character, making it clearer for the developer. To express our character's decision which is made based on their personality, we will use dialogue to express the companion's decision which also reflects their personality. As previously mentioned, we chose Cloninger's psychobiological model of temperament and character to guide the development of our personality model for companion characters in videogames. Cloninger's psychobiological model of temperament and character is capable of translating the assertiveness and cooperativeness axes from Thomas' Dual-Concern Conflict model, to the *Cooperativeness* trait in whether a person has interest in helping others or is only self-interested, and *Self-Directness* trait to determine if a person has a lack of goal direction (i.e. no interest in personal goals). But the added four temperament traits, will allow us to define with more precision our characters' personality. Caroline Faur et al.[7] argued that the socio-cognitive approach to personality takes into account the context of the situation, but makes the definition of a character's personality more complex. As a result, we opted for a personality trait model. But not neglecting the importance of context on a situation, we developed a tag system.

Adapted Personality Model (APM)

To guide us in this process of creating a personality trait model, we selected Cloninger's psychobiological model of temperament and character. This in turn, can help us ensure that our model takes into account the majority of a character's possible behavioural patterns. The traits defined by our personality trait model for companion characters are inspired by the Cloninger's psychobiological model of temperament and character traits, but do not strictly follow their definitions. Also, the number of traits the we have defined in our model allows us to modulate most of the characters'

behaviours. The traits definitions are the following:

Novelty Seeking: Translates into adventurous and curious behaviour, to seek thrill in new things and areas. Characters will actively try to find new activities and unexplored paths. It is also responsible for the search of rewards, being those practical or emotional. Dissimilar to the definition of Novelty Seeking in the Cloninger's psychobiological of temperament and character, ours mainly focus on exploratory excitability and impulsiveness small order traits;

Harm-Avoidance: Reflects a character's courage and confidence. A character that possess high Harm Avoidance will avoid high risk situations, such as fighting an enemy while a character with low Harm Avoidance can be seen as careless when in face of danger. Unlike Cloninger's Harm Avoidance trait definition, which also express the person's shyness and fatigability. Our definition focus in the avoidance of dangerous and uncertain of situations;

Reward-Dependence: Characters that posses low Reward Dependence better respond to practical rewards, such as money or equipment, while characters with high levels on this trait are highly responsive to emotional support. Contrary to the definition of this trait in the Cloninger's psychobiological model of temperament and character, this definition focus in the preference of rewards. We also defined the empathy towards NPCs in this trait;

Persistence: Conducts the resoluteness and ambition of a character. If a task requires high effort, a character with low levels in this trait will abandon or avoid to do such tasks. Our definition focus mainly on work hardened and ambitiousness small order traits from the original definition. Furthermore, we define character fatigability in this trait;

Self-Directedness: Translates into willpower. Allowing us to define the "will" of a character in order to pursue its goals. Unlike Persistence, this trait only influences the "will" of the character to seek its goals. This means while a character with low Persistence may constantly change its actions, if it possess high Self-Directedness its will to pursue the goal won't change. This trait mainly focus on the will of the character to seek its own goals, rather than the purposefulness and self-acceptance of the character from the definition of the Cloninger's psychobiological model of temperament and character;

Cooperativeness: Responsible for defining the helpfulness of a character. The higher the values in this trait, the more helpful the character will act towards the player. The lower, the less helpful the companion will be. This trait does not focus on the empathy, social acceptance or pure hearted consciousness like the original definition in Cloninger's psychobiological model of temperament and character. But mainly in the definition of helpfulness towards the player.

Henceforth, the traits will be referring to the Adapted Personality Model (APM) traits.

Framework For Companion Characters

PONTiFF's purpose is to give the illusion of personality to a companion character, and to accomplish this we have 3 components in our framework : the companion character's personality, the companion character's decision making, and the tag system.

Companion character's personality: is a set of values per trait which define the character's personality. These values are bound between 0.0 and 1.0.

Decision making component: is determined by trigger regions, that will define points of decision for the companion character to make. These regions feature N different options, from which the companion character will choose. Each option will define a value between 0.0 and 1.0 for each of the APM's traits.

Tag system: purpose is to add context information to the decision. As such, tags define a value between -1.0 and 1.0 for each of the APM's traits, that will change the contribution of these in an option (i.e. change the base value of the trait(s) of an option). The tags are used by the game designer to "tag" important "things". These "things" can be, for instance, a dialogue with a NPC which can disclosure a location of a treasure or a possible monster, that can influence the decision of the character based on this new gained knowledge. For example: a game designer can create a tag with 0.5 in the Novelty Seeking trait, that when the player reads a note, a map, eavesdrop a conversation that disclosures a hidden path, that tag is activated. This in turn, will increase weight of the Novelty Seeking trait in that option by 0.5. The designer can create different kinds of tags, which can have different purposes. But, a tag will always have to define the weight change that will be made in the option, if it wants to impact a decision. We implemented 2 different tag types, although developers can create more if needed. The implemented tag types were:

- **Knowledge tag:** A knowledge tag represents the knowledge gained by the companion character. This tag is the only tag that has a state, whether active or inactive. The tag is inactive when the player does not know of the knowledge that this tag represents, this is the start state of the tag. When the player gains that knowledge, the knowledge tag becomes active.
- **Objective tag:** An objective tag is used to define the companion's objective. An objective tag has the purpose to influence the decisions that go according to the companion's objective.

The knowledge tag is used to influence the character's decision based on NPC dialogue with pertinent information about a certain decision. The objective tag is used to define the companion's objective.

Because tags can have negative values, if an option's weight value after adding the tag value is negative, we set it to 0. We also normalize the weight values after the addition of the tags in an option, to avoid the game designer keeping track of the total percentages. In the end, the companion will

choose in the decision the option with the highest value, calculated with the equation 1.

$$\sum_{i}^{traits}\left(\frac{decisionWeight_i+\sum_l tag_{l,i}}{\sum_{k}^{traits}(decisionWeight_k+\sum_m tag_{m,k})}\right)*characterTrait_i \quad (1)$$

After reaching a decision, the character will communicate the selected option, and explain the choice made via a dialogue message. The dialogue message is composed by two parts. The first part (decision) contains the information about the option, where the second part (trait) contains the reason of why that choice was made based on the trait that impacted the most the decision. To find which trait was the one that impacted the most a decision, we first look at the values of each trait before the sum of all trait values, as seen in equation 2.

$$utility_{trait}=\left(\frac{decisionWeight_{trait}+\sum_l tag_{l,trait}}{\sum_{k}^{traits}(decisionWeight_k+\sum_m tag_{m,k})}\right)*characterTrait_{trait} \quad (2)$$

In addition, the message dialogue subject changes according to the character's Self-Directedness and Cooperativeness trait values, with the objective to reinforce the character's personality. So, depending on whether the Self-Directedness and Cooperativeness trait values are bigger or not than 0.5, this results in a different subject, as shown in table 1. We chose to use English, because of its practicability.

Self-Directeness ≥ 0.5	*Cooperativeness* ≥ 0.5	Subject
True	True	We
True	False	I
False	True	You
False	False	It

Table 1: Subject Table

To help the creation of these dialogue messages, we developed macros and generic sentences for the companion to say. The generic sentences for the first and second parts are the following:

decision: "Maybe ... should go to ...".

decision (it): "Maybe got to ..."

Novelty Seeking: "Maybe ... can find something new."

Novelty Seeking (it): "... seems there's something interesting there"

Harm Avoidance:"So ... can avoid danger."

Harm Avoidance (it):"... seems the safest option."

Reward Dependence:"So ... can get something out of it."

Reward Dependence (it):"... seems the most rewarding."

Persistence:"... can get us through this."

Persistence (it):"... can be done."

Self-Directedness:"... need to go there!"

Self-Directedness (it):"Don't really care."

Cooperativeness (I):"So ... can help you."

Cooperativeness (you):"So ... can help me."

Cooperativeness (we):"So ... can help each other."

Cooperativeness (it):"If you want."

The developed macros were the following:

%s or %S: replaced by lower and upper cased of the subject in the table 1, respectively;

%pr: replaced with the object pronoun of the subject, according to table 1;

%ps: replaced with the possessive pronoun of the subject, according to table 1;

%g: replaced with a generic sentence for each specific part;

%0: used to define the sentence as empty.

An example of the use of macros from our scenario is when the companion is deciding to whether go help villager or seek treasure, "%S should go to the left, for the canyon"(decision), "Let's go for the canyon."(itDecision), and with one of the explanations "Maybe %s should go help the people in the oasis.".

Because our sentences' subject can change depending on the character's Self-Directedness and Cooperativeness traits, a draw between options will be handled according to the subject table, table 1. If the companion character's levels of Self-Directedness and Cooperativeness traits results in the pronoun "We", then the character will choose one the options, with equal chance, but also say "But either option is good". Transmitting the idea the companion cares about the player's choice. If the companion character's levels result in the pronoun 'I', then the character is self-centered and will choose one of the options, equally, but without adding anything else. If the companion character's levels result in the pronoun "You", then the companion mainly focus on the player rather than itself, as a result the companion will say the trigger region *indecision text* and adding "I leave it up to you". Finally, if the companion character's levels result in the pronoun "It", then means that the character does not care about herself nor the player. Thus, the companion will only say the *indecision texts* defined by the trigger region.

Development Environment

To implement our personality model and our framework, it was decided to use a modding tool rather than a game engine. Since, modding tools often provide the in-game assets. Nevertheless, there are some games from different genres that support modding tools. But, the customization that each modding tool offers differs from one another. From the available modding tools, we selected Starcraft 2 Editor. Starcraft 2 Editor was released with Starcraft 2, a game that possess an active competitive scene. Starcraft 2 has good playability and the release of the Arcade system (a hub for different mods for Starcraft 2) in June of 2012, allowed the nourishment of the creation of different game modes and genres using Starcraft 2 Editor with success. Furthermore, Starcraft 2 Editor allows its user to create and customize assets (units, abilities, special effects, etc.), being those already existing or new. Unlike some modding tools, Starcraft 2 Editor also allows to code, via scripts or code blocks. Enabling us to customize individual units Artificial Intelligence (AI), customize the User Interface (UI), and much more.

Test Scenario

To create a test scenario similar to a game, it was decided to create eleven different maps. The transition between each map is dictated by the each trait of the personality model with the exception of self-directedness. Self-directedness is related with the companion's objective, so this behaviour should be observed along all maps. This approach allowed us to create a story for the player to follow, and simultaneously allow the companion character to express its personality. This layout is similar to an acyclic graph, see figure 1.

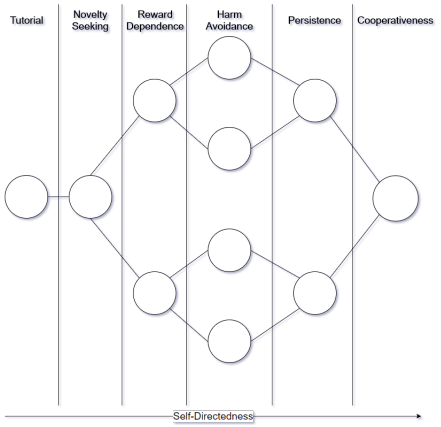

Figure 1: Test scenario layout

For example, after completing the tutorial, the player will move to the city. In the city, the companion will meet and join the player. The first decision that the player and the companion will face is whether to proceed to the forest (upwards) or to the desert (downwards). This decision is to allow the companion to express the Novelty Seeking trait. If the companion chooses forest then it chose the safest option, instead of choosing to explore the desert.

Companion characters

To test our framework, we created three companion characters. A sorceress character, a warrior character and a random character. Due to time restrictions, we were unable to gather enough data to evaluate the warrior character. As a result, we will mainly focus on the sorceress and the random character.

Companion characters' AI

Starcraft 2 Editor provides an aggression behaviour, which detects any nearby enemy and orders the unit to attack it, and patrolling movement for individual units' AI. Since, our scenario features combat situations, we decided to also influence the combat decision based on the companion character's personality. As a result, we customized the companion units' AI. The companion character featured a simple decision tree, showed in figure 2.

The traits that impact the chance of the character to fight or run are: Harm-Avoidance, Reward-Dependence, Persistence, Self-Directedness, and Cooperativeness. Based on the

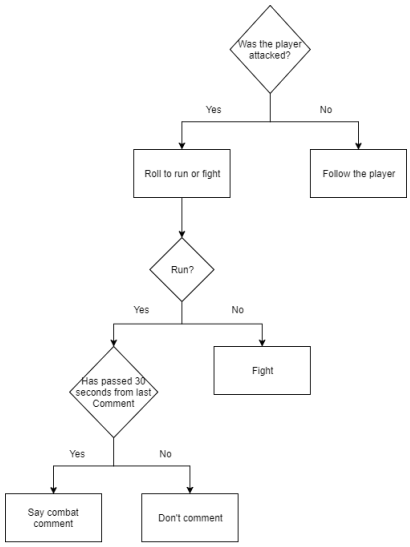

Figure 2: Companion's decision tree

companion's personality values, we will calculate the probability for the companion to run or fight. Similar to our decision making, depending on the trait that most influenced the companion to run, the companion will say a dialogue sentence based on the trait with the highest value:

Harm Avoidance: "It is too dangerous."

Harm Avoidance (2 or more enemies): "There are too many of them."

Reward Dependence: "It is not worth it."

Persistence: " I am tired, give me a second."

Self-Directedness: "I have nothing to do with this."

Cooperativeness: "It is your problem, I cannot help you."

Because combat is a common challenge, we added a 30 second interval between each comment.

Sorceress Character

The sorceress character and warrior character had their personality contrast between each other. Since, the personality given to the sorceress character was the following: 0.3 (low) in Novelty Seeking , 0.8 (high) in Harm-Avoidance, 0.2 (low) in Reward-Dependence, 0.8 (high) in Persistence, 0.3 (low) in Self-Directedness, and 0.8 (high) in Cooperativeness. Then, the warrior character's personality is the inversion of these values, $1 - sorceress_{trait}$. This personality distribution means that the sorceress character is unadventurous, fearful, cold, persistent, non-ambitious and highly cooperative.

Random Character

The random character's purpose is to serve as a neutral personality character, which has an inconsistent random personality. The random character will choose randomly between available options. After the companion make its decision,

the algorithm will determine what is the trait that most influences the sorceress on this decision. To determine which trait would influence the sorceress' decision, the algorithm identifies each trait with an integer. Then a random number between 0 to 5 is generated (0 is associated with Novelty Seeking to 5 is associated with Cooperativeness). If random number is different from the one that would be selected by the sorceress, then the trait that is identified by the real number will be selected. Otherwise, another random number is generated. To avoid causing an infinite loop, the number generation is limited by five random numbers. When this character enters in combat, its traits are randomized, varying the probability of this character to help in combat.

Evaluation Methodology

Our evaluation process was divided into two phases. The first phase was a preliminary hand-on test made available at Montra de Jogos (MOJO) of *Instituto Superior Técnico*. The second phase was composed by an online questionnaire.

Montra de Jogos (MOJO)

At MOJO, we made our test scenario available for attendees of the event. When an attendee asked to play the scenario, we would ask the player to take special attention to the companion's dialogue. From there, the attendee would play the entire scenario by himself. The feedback that we started receiving was that, upon responding to the questionnaire, the attendee started focused more on the game mechanics rather than the companion itself. This clearly meant a problem, because we wanted to evaluate the attendee's perception of the companion character's personality. It was then decided that our evaluation needed to allow the users to focus on the companion's interactions rather than the game mechanics.

Online Questionnaire

This resulted in the creation two online questionnaires each with a video of one of the companions, sorceress and random character. This questionnaires were shared via a *PHP* redirection webpage (single link) to avoid participants to answer the different questionnaires. The questionnaires were divided into 3 sections: a demographic section, model impression, and description of the companion character based on the gameplay video. The demographic section allows us to retrieve the age of the participants, their dedication to videogames, and whether they have experience with the Action Role Playing Game (ARPG) genre. The model impression evaluates the participants' first impression of the personality from the model character. In order to evaluate this first impression, the participant answers a 6 4-point Likert scale (Fully Disagree, Disagree, Agree, and Fully Agree) items for each trait. Afterwards, the participant sees a gameplay video of a complete run of the test scenario. The participant will then describe the companion character with 1 to 3 adjectives. Finally, the participant answers a sixteen 4-point Likert scale items. These 16 items are composed by 6 items that analyse a trait in the positive form, 6 items that analyse a trait in the negative, and 2 items to mislead the participants about the actual purpose of the questionnaire, each with a positive and negative form. Redundancy on the items serve the purpose to evaluate the attention and honesty of the participant, and validate our questionnaire. The 6 items from the model analysis are the same as the 6 items that analyse in the positive form each trait. The items that composed the questionnaires are the following:

Dedication to videogames item scale

d1.1 "I don't play digital games."

d1.2 "I play digital games occasionally when the opportunity presents itself."

d1.3 "I make some time in my schedule to play digital games."

Experience with an ARPG item scale

d2.1 "I don't play digital games."

d2.2 "I play digital games but I am not very familiar with the Action Role-Playing genre."

d2.3 "I am familiar with the Action Role-Playing genre."

Novelty Seeking items

1. "The companion wants to explore new areas and find new things."
2. "The companion prefers to go to paths that she knows rather than new ones."

Harm Avoidance items

3. "The companion wants to avoid danger and risky situations."
4. "The companion is fearless."

Reward Dependence items

5. "The companion is a warm character, capable of skipping possible rewards (such as treasures), to seek others."
6. "The companion prefers to seek treasure rather than seek others."

Persistence items

7. "The companion persists when he/she is faced with an obstacle/challenge or is fatigued."
8. "The companion easily gives up when he/she is tired or faced with an obstacle/challenge."

Self-Directedness items

9. "The companion only cares about his/her objectives."
10. "The companion doesn't care about his/her own objectives."

Cooperativeness items

11. "The companion cares about the player and gives tips to help the player overcome the challenges."
12. "The companion is uncooperative and doesn't help nor gives tips to the player."

Misleading items

Smarter

13. "The companion is smarter than the player."
14. "The companion is dumber than the player."

Stronger

15. "The companion is stronger than the player."
16. "The companion is weaker than the player."

Results

In this section, we will analyse the results retrieved from the online questionnaire, and discuss them. All data analysis was made via IBM SPSS Statistics®version 24.0.0.0. Our 4-point Likert scale (*Fully Disagree*,*Disagree*, *Agree*, *Fully Agree*) is organized into a ordinals from 1 to 4, 1 to *Fully Disagree* and 4 to *Fully Agree*. To convert both forms of each trait into a single scale variable for each trait we used equation 3. This variable will be called combined variable, henceforth. It was also created an auxiliary variables for each negative form item, which is the negative form item converted into the positive form item. These variables will be called auxiliary form variable.

$$(PositiveForm + (5 - NegativeForm))/2 \quad (3)$$

To test whether our distribution follows a normal distribution or not, a Shapiro-Wilk test was applied to our combined variable for both the sorceress and the random character data. The null hypothesis states that the tested distribution follows a normal distribution. As the data presented in table 2, only Novelty Seeking presents a normal distribution in both the sorceress($p = 0.165$, $p > 0.05$) and the random character ($p = 0.277$, $p > 0.05$) data. However, since all the other traits do not follow a normal distribution on both sets of data, all our tests will be with non-parametric statistical methods.

Trait	**Sorceress** p	**Random** p
Novelty Seeking	0.277	0.165
Harm Avoidance	0.002	0.009
Persistence	0.174	0.002
Self-Directedness	0.035	0.106
Cooperativeness	0.012	0.011

Table 2: Shapiro-Wilk test results

Sample distribution

From the 33 participants, 26 are male, 6 are female and 1 is transgender, with ages between 15 to 37 ($M = 24.30$, $SD = 4.889$). 63.6% of our participants schedules their time to play videogames, 27.3% plays videogames when time allows, and only 9.1% do not play videogames. Furthermore, 66.7% of our participants are familiar with ARPG genre, 24.2% are not very familiar with ARPG genre, and 9.1% do not play videogames. This indicates that the majority of our participants are dedicated gamers and are familiar with the ARPG genre.

Questionnaire validity

To verify the validity of our questionnaire, we need to check whether the positive and negative form items associated with each trait are correlated. As such, we applied Cronbach's alpha to test the reliability of our pair of items from each trait. Cronbach's alpha was applied to the auxiliary form variable and the positive form of each trait. As show in table 3, nearly all items were correctly evaluated by the participants, with the exception of Reward Dependence.

Trait	**Cronbach's alpha**
Novelty Seeking	0.857
Harm Avoidance	0.606
Reward Dependence	0.047
Persistence	0.872
Self-Directedness	0.605
Cooperativeness	0.798

Table 3: Cronbach's alpha value in pair of trait items

The low value of Cronbach's alpha of Reward Dependence, $p_T = 0.047$, indicates that the auxiliary form variable and positive form item of this trait are not correlated. Which means, that this trait was not correctly constructed on the questionnaire. As a result, it is not possible to extract further conclusions from Reward Dependence. Subsequently, this trait will not be part of our analysis.

First impression results

To verify if the character's graphical design has an influence on personality reporting, we used Wilcoxon signed test. The Wilcoxon signed test was applied to the items of the first impression evaluation and the combined variables corresponding to each trait. The results presented in table 4, show that Harm Avoidance, Persistence, Self-Directedness and Cooperativeness present a statistical significant difference ($p < 0.05$). While, Novelty Seeking did not show any statistical significance ($p > 0.05$). These results show that the first impressions of the character's personality did not hold in the final impression of the companion character, after watching the gameplay video. Which suggests the importance of exposing the character's personality via in-game behaviour. This also shows that our participants were focused on the companion's behaviour, unlike what happened in our first evaluation methodology. Independently of these results, it does not mean that developers should neglect the model aesthetics, because this component can be used to reinforce a character's personality.

Trait	Z	p
Novelty Seeking	-0.919	0.358
Harm Avoidance	-3.161	0.002
Persistence	-2.888	0.004
Self-Directedness	-2.125	0.034
Cooperativeness	-2.662	0.008

Table 4: Wilcoxon signed test results

Furthermore, we applied a Mann-Whitney U test to the evaluation of the first impressions between the group of participants who evaluated the random and sorceress character. As shown in table 5, the results show no statistical significance between the evaluations ($p > 0.05$).

Trait	p
Novelty Seeking	0.287
Harm Avoidance	0.508
Persistence	0.879
Self-Directedness	0.596
Cooperativeness	0.756

Table 5: Mann-Whitney U first impression results

Companion personality perception

To verify if the participants were able to correctly assess our sorceress' personality, we applied a Mann-Whitney U test to the combined variable of each trait on both data sets. The results displayed in table 6 do not show any statistical significance ($p > 0.05$).

Trait	p
Novelty Seeking	0.519
Harm Avoidance	0.168
Persistence	0.075
Self-Directedness	0.085
Cooperativeness	0.677

Table 6: Mann-Whitney U results

But, as showed in table 7, we can see a clear high evaluation on the traits of Harm Avoidance and Cooperativeness, which goes according to the sorceress' personality. Whereas Novelty Seeking, Persistence and Self-Directedness have the participants split among all levels. These results indicate that these traits were not correctly perceived by the participants. Additionally, the adjectives used to describe sorceress character seem to be mainly focused towards the Harm Avoidance trait, with adjectives such as: fearful, cautious, coward, careful, and afraid. Cooperativeness appears to also present some relevance in the adjectives, with helpful occurring 12.12%.

Trait	1.00 %(#)	1.50	2.00 %(#)	2.50 %(#)	3.00 %(#)	3.50 %(#)	4.00 %(#)
Novelty Seeking	13.3 (2)	26.7 (4)	20.0 (3)	13.3 (2)	20.0 (3)	0 (0)	6.7 (1)
Harm Avoidance	0 (0)	0 (0)	0 (0)	0 (0)	33.3 (5)	26.7 (4)	40.0 (6)
Persistence	13.3 (2)	13.3 (2)	33.3 (5)	6.7 (1)	13.3 (2)	6.7 (1)	13.3 (2)
Self-Directedness	0 (0)	0 (0)	33.3 (5)	26.7 (4)	13.3 (2)	20.0 (3)	6.7 (1)
Cooperativeness	0 (0)	0 (0)	0 (0)	13.3 (2)	40.0 (6)	13.3 (2)	33.3 (5)

Table 7: Frequency of evaluation on the sorceress character

The results indicate that the current version of the framework is not enough, in the implemented scenario in particular, to fully express a personality distribution. However, we validated that there were traits of sorceress that were correctly perceived by our participants, Harm Avoidance and Cooperativeness. One reason for which Harm Avoidance might have been so clearly observed by the participants, is because of combat. Combat is a common challenge in the scenario and Harm Avoidance is the trait that most influences the sorceress to avoid combat. Which means that this trait is often exposed in the game scenario. In the case of Cooperativeness, there might be two reasons for to be so clearly assessed by our participants. This trait's interaction is last interaction to be made by the companion, making it the most recent interaction upon answering to the questionnaire. The second reason might be, because of all interactions are made by the companion are written dialogue. Since the nature of Cooperativeness is to define how much helpful the companion is to the player and how all interactions are written dialogue, this may indicate that this is the best way to expose this trait. Therefore, it seems that the problem is not in our framework but in the way in which the perception of the random character was not sufficient to evidence something statistically significant. One of the factors may be not enough time to make these differences obvious. On the other hand, each participant only interacted with one character, without the other character for comparison, makes it difficult to the participants to evaluate the character's personality in-game, since the participant is seeing everything for the first time.

Conclusions

In this work, we proposed to define a personality model and a generic framework for companion characters with the focus in videogames. To achieve this, we reviewed three different personality models from the psychology literature. Upon which, we found Cloninger's psychobiological model of temperament and character to be in more agreement with the focus our work. With this decision, we defined our personality trait model for companion characters, inspired by Cloninger's psychobiological model of temperament and character. For the creation of our generic framework for companion characters in videogames, we analysed different works that implement personality in synthetic characters. Based on the analyses of the reviewed works, we decided that our generic framework was going to be composed by three components: the character's personality, decision system based on the character's personality, and a tag system to keep track of the character's experience, knowledge, objectives, etc. To implement our generic framework, we opted for a modding tool, from which we selected Starcraft 2 Editor. It was in this modding tool, that we also developed our test scenario. Our scenario was designed to provide an experience similar to a videogame. In our scenario, the transition between each map in our scenario was dictated by the each trait of the personality model with the exception of self-directedness. Since, Self-Directedness is related with the companion's objective, so this behaviour should be observed along all maps. To test our work, we used an online questionnaire. In this questionnaire, we were interested to evaluate if the character graphical design has an influence on personality assessment and if the companion personality conveyed by our model is adequately perceived by the player through interaction. Our results indicate that the in-game behaviour is more important than first impressions induced by the character design, and that Harm Avoidance and Cooperativeness traits were easily understood by the participants.

Future Work

This leads us to possible future work. Videogames often use cutscenes to express the character's personality. This might be, because players do not need to interact with the game, so they can focus entirely on the cutscene. But, our results show

the importance of expressing the character's personality in-game. As such, we propose as future work to study what is the most efficient way to express a trait. Either through voice acting, written dialogue, body motions, behaviour, combination of previous, or other. For example, Novelty seeking could be better understood by participants, when expressed with body emotions, rather than solely expressed with written dialogue. In our current implementation of our tag system, the designer needs to manually tag in-game events to allow these to influence a decision. So we propose as another possible future work, the development of a procedural generation algorithm that creates tags based on the detection of in-game events. For example, when a player chooses a different option from the companion character, an affinity tag is created which decreases the weight of Cooperativeness on future decisions.

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