Moody5: Personality-biased agents to enhance interactive storytelling in video games

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***Abstract*—In story-driven video games, such as Role-Playing Games (RPGs), a static and repetitive interaction with Non-Player Characters (NPCs) can negatively impact fun and immersion. On the contrary, an NPC able to show emotions and endowed with a personality that matches its behavior can keep the user engaged for a longer time. Unfortunately, this aspect has not yet been fully investigated. We propose Moody5, a preliminary solution designed to help game designers create "personality-biased" agents able to interact in sensible ways in the framework of interactive storytelling. In particular, it supports the creation of agents that exploit the Goal-Oriented Action Planning (GOAP) technique to reach their goals but whose chain of actions and quality of the interaction with the player are dynamically affected by personality and emotions. To obtain this result, we have borrowed ideas from the Big Five theory [1] and the Emotion Facial Action Coding System (EMFACS) by Ekman & Friesen [2]. We validated the proposed solution in a narrative test scenario inspired by the Harry Potter universe. Our preliminary survey demonstrated that Moody5 could improve the gameplay experience and replay value while providing a helpful Unity plugin for game developers.**

***Index Terms*—interactive storytelling, Goal-Oriented Action Planning, believable NPCs for games, artificial intelligence techniques, Big Five theory, emotion simulation, personality traits.**

I. Introduction

Unlike traditional media, video games provide mechanisms for users to interact with the environment where the narration occurs [3], thus transforming the user from a passive spectator into an active participant. Therefore, the interactive storytelling in a video game is not necessarily linear, and unexpected twists in the plot can be triggered by the interactions between the player and Non-Player Characters (NPCs) [4]. An NPC is an artificial character that helps the game world "come to life" [5], and that can have roles and objectives of its own. Games - and especially story-driven ones - are experiences designed to entertain the players and move them emotionally [6]. Hence, when the players are aware that their decision matters (i.e., impacts on the development of the plot), the replayability of the game increases, keeping the user engaged for a longer time [5], e.g., to repeat the adventure to try to reach different endings. In this perspective, the role of NPCs can become crucial [4], especially when the NPC shows a personality that matches its behavior, demonstrates awareness of its surroundings, and expresses its emotions [7]. In (multiplayer) story-based games, where the narrative counts for a significant amount of the gameplay value, such as Role-Playing Games (RPGs), a static and repetitive interaction with NPCs can hinder the fun and the immersion in the game for the players. Therefore, it would be desirable to enhance the characters' behavior by making their interactions with the player and the game world appear more spontaneous.

Our work aims at proposing an approach useful for creating convincing NPCs, able to show peculiar personality traits and emotional reactions during their interactions with players by leveraging appropriate techniques of Artificial Intelligence (AI). In particular, we try to mimic the effect of a subset of emotional states in the NPCs for a story-driven game by embedding into them features designed on the basis of psychological personality and emotion theories. To this extent, we have designed, developed, and tested Moody5, a plugin for Unity3D that allows the game designer to create personality-biased agents able to interact with the game world and react to emotional stimuli. In particular, the agents exploit Goal Oriented Action Planning (GOAP) to reach their goal. At the same time, they are also "personality-biased", in the sense that they include a "personality model" based on the theory of the Big Five [1], and an "emotional state" based on the studies of Paul Ekman [8]. Consequently, their behavior is affected by what is happening in their surroundings and by their personality and current emotional state, thus providing complex agents able to react to specific external stimuli. Last but not least, although Moody5 is still in its infancy, to validate at least its overall approach, we built an RPG demo scenario to test its usability and the gameplay experience it can provide.

The remaining of this work is organized as follows. Section II briefly summarizes related works with a focus on interactive storytelling and agents endowed with personality-based models and then analyzes the most promising psychological approaches for our purpose. Section III describes Moody5, laying out its foundations in the psychological theories and the AI techniques it implements. Section IV describes the methodology used to validate Moody5 and the preliminary results we have obtained so far. Finally, Section V concludes the work and highlights opportunities for future research.

II. Related Work

This section starts by briefly presenting several examples of commercial games and state-of-the-art studies to produce

narratives in which the personality, emotion, and action of NPCs or characters play a relevant role. In the following part of the section, we quickly examine some of the most relevant studies (from our perspective) on personality and emotions, debating the advantages and disadvantages of exploiting different theories for our scope.

A. Interactive storytelling

Interactive storytelling requires that a certain amount of the narrative elements of a story emerge from the interactions that the player has with the environment, and other characters, including NPCs [6]. Crawford [3] discusses three potential strategies for developing interactive stories for games: (i) interactions with the environment (narrative events emerge from the interaction between the player and the game); (ii) data-based strategies (which use libraries of story components to generate consistent combinations of events in response to user actions); and (iii) approaches exploiting natural language (allowing the user to exploit a - limited - vocabulary to interact with the game system). In the last few years, several games and works have been setting the state-of-the-art in interactive storytelling, applying different approaches [4], [9]–[11]. Heavy Rain (2010) and Become Human (2018) by Quantic Dream are only some recent examples of commercial games that exploited multiple storylines which develop based on the player's choices, thus transforming the overall game experience. Life is Strange (2015) by Square Enix is a graphic adventure that allows players to rewind time to change past actions, thus modifying the development of the plot. Animal Crossing (Nintendo) and The Sims (Maxis, Electronic Arts 2000) use NPCs to develop the story. Each NPC in Animal Crossing has one out of eight different personalities that influences its habits and interests. Nonetheless, NPCs do not have explicit goals nor show convincing emotions, thus producing repetitive interactions. On the other hand, Sims are controlled both by the player's actions and by their AI, and they plan their actions to satisfy their physical and emotional "needs". However, The Sims' complexity is not reflected in the narrative, which is largely underdeveloped.

On the academic side, Cavazza *et al.* [4] studied the generation of behaviors of characters that interact with each other within a story. Each character is driven by long-term goals achieved through a planner defined by Hierarchical Task Networks. However, the work does not analyze the personality traits of the agents, which could trigger changes in the NPCs' behavior, thus improving the player experience. Shirvani *et al.* [9], propose a context-free representation with a simplified Big Five personality model. They describe traits using a set of aspects, as defined by DeYoung *et al.* [12] (such as defining an agreeableness trait through kindness and compassion aspects). Agliata *et al.* [11] proposes a tool that allows the creation of NPCs sensitive to changing emotions, using decision trees and genetic algorithms to add variability to the gaming experience. However, their work does not discuss the usage of personality models and GOAP in the NPC definition. A particular inspiring work is that by Bahamòn *et al.* [13]: they developed a planning-based approach to the generation of narrative. Their model automatically produces plots whose development can be influenced by the characters' personalities. Hence, modifying some personality traits of one or more characters can automatically generate different storylines. Unfortunately, although this approach is sound and intriguing, it is - in its current form - quite useless for creating *interactive* narrative. It generates "static" stories that can be, e.g., read (as the tester in Bahamòn's work did) but are not meant to be used in any interactive media.

B. Theories about Personality

Personality is a complex organization of ways of being, knowing, and acting that guarantees unity, coherence, continuity, stability, and planning for the individual's relationships with the world [14]. In the context of personality studies, two among the most relevant theories are based respectively on the psychological *types* and *traits* shown by individuals [15], [16].

The "personality type" theory classifies the personality of an individual by relating it to the characteristic behavior of a species or a community [15]. One of the more notable works is the Myers–Briggs Type Indicator (MBTI) [17]. Based on Carl Jung's [15] studies, MBTI identifies psychological characteristics that describe how an individual interacts with the world and which is their attitude toward life in general [17], obtaining 16 different psychological "types". However, the model has several disadvantages: it neglects emotional instability and employs not-so-accurate tests for the classification of the personality [18]. The "trait" theory is based on the assumption that individuals are naturally predisposed to manifest behavior that derives from their temperament [19]; hence a personality is the "sum" of the traits composing it [20]. In this framework, Eysenck's study [16] defined the PEN model, which classifies personalities based on three dimensions: psychoticism, extraversion, and neuroticism. However, Delfard & Kringlen [21] raised critics of Eysenck's theory since - while trying to demonstrate the genetic influence on personality - they obtained conflicting and inconclusive results.

In 1992, the studies conducted by [1] showed that a personality could be described through five "dimensions", whose impact can be measured using the questionnaire developed by Caprara *et al.* [14]. The model is called Five-Factors (or Big Five) and is one of the most robust and comprehensive personality models currently used in psychometric testing [12]. More than 80% of the personality variations that can be observed in the human population can be modeled using the Big Five, thus making it the current most reliable model to describe personality [1]. The five macro-categories (or dimensions) used to describe differences between individuals are: *openness to experience*, *conscientiousness*, *extraversion*, *agreeableness*, and *neuroticism*. Due to its great recognition in psychology and the additive nature typical of the trait theory, the Big Five has been chosen as the basis for modeling the personality of Moody5's NPCs (see Subsection III-A2).

C. Theories about Emotions

An emotion can be defined as a complex subjective experience accompanied by intense - but usually short-lived - cognitive, behavioral, expressive, and physiological changes [22]. Among the vast plethora of theories on emotion, for our purposes, we have considered those based on neurophysiological, appraisal, and evolutionary approaches.

The *neurophysiological* theories study the physiological mechanisms underlying the generation of emotions. They are divided into two opposite branches: peripheral and central theories. The *peripheral* theory is described by James & Lange [23], and it argues that emotions are perceived through a physiological process triggered by an external stimulus. The *central* theory counters the peripheral approach, arguing that the internal organs of the body have reduced sensitivity and response times too slow to be considered the place of origin of emotions [19]. Anyway, both branches of neurophysiological theories are somewhat incomplete since they disregard psychological aspects in the generation of emotions. This limit has been overcome by Schachter [24] and his *appraisal* theory, which aggregates physiological and psychological components.

Starting in the 60s, a group of psychologists developed a *psycho-evolutionary* theory of emotions based on Charles Darwin's studies. They stated that emotions, manifested through facial expression, are the product of natural selection [25]. Tomkins [26], in particular, considered emotions innate response patterns that have been developed to guarantee the suitability (and survival) of individuals. Ekman & Friesen shared this observation, proposing one of the main innovations for inferring emotional states from facial recognition: the Facial Action Coding System (FACS) [8], which describes the meaning of facial expressions by analyzing facial muscles. Despite critics - claiming that some emotions do not always have a unique correspondence with facial expression [27] -, Ekman & Friesen's work is still one of the most diffused tools to classify emotions. On the foundation of FACS, Ekman & Friesen created the Emotion FACS (EMFACS) [2], a widely adopted system to infer the emotional state of an individual from their facial expressions. EMFACS includes six "primary emotions": *joy*, *sadness*, *anger*, *fear*, *disgust*, and *surprise*. Moody5's emotion model, as described in Subsection III-A3, adopts Ekman's EMFACS approach to simulate primary emotions in NPCs [2].

III. Moody5

Moody5 is a Unity plugin that supports the creation of personality-biased agents that interact with the game world within a narrative context. As shown in Fig.1, it provides game designers with an editor to set up an agent and its personality (Moody5 Agent Editor), a visual editor (Dialogue Graph Editor) for the creation of a set of alternative dialogue lines that the NPC will use during the interaction with the player - according to the emotions and the personality of the agent -, and an interface to monitor the agents' behaviors at runtime (Display Manager), in terms of actions that the agent decides to do and of its emotional state. Additionally, the

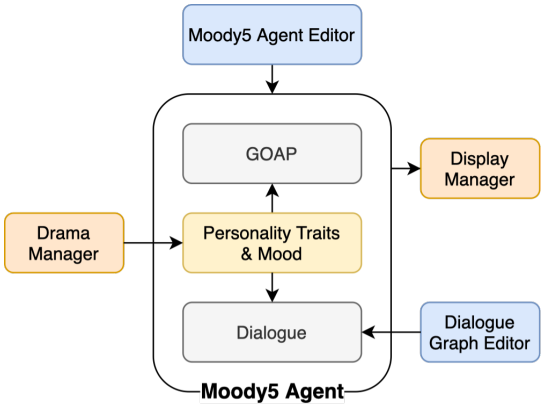

Fig. 1. Moody5 agent structure and supporting framework modules diagram.

Drama Manager module handles the generation of some story events. These events can impact the behavior and emotional state of one or more agents, thus triggering some re-planning (using GOAP) or modifying the dialogue line choice based on the NPC's new current "mood". The behavior of each agent is regulated by an ad hoc version of the GOAP algorithm, sensitive to the NPC personality and emotional state. In particular, we borrow concepts from the Big Five theory and Ekman's primary emotions for simulating emotions. At the same time, we model personality traits extending the work by Ciadamidaro [10], which implements a version of GOAP for very simple NPCs in Real Time Strategy (RTS) games. Its main aim is to provide some behavioral variety among the NPCs by endowing them with a "dynamic bias" that mimics some specific personality traits. For example, an agent may be scared by water; consequently, to reach a location, it will pick a different path from the rest of its group to avoid crossing a river. Nevertheless, this solution does not include any simulation of emotions or dialogue-based interaction with the player, nor the possibility for the agent to affect the overall development of the narration. Last but not least, it does not provide any editor nor the opportunity to monitor the agents at runtime.

Moody5 has been implemented using Unity3D and some of its libraries (MonoBehavior, ScriptableObject, EditorWindow, and GraphView), while RPG Maker MV by Enterbrain has been used to create assets for the test scenario.

A. Moody5 Agent Structure

To provide more flexibility to designers, Moody5 can produce two different types of agents: *Emotional NPCs* and *Moody5 Agents*. Both types implement Ekman's primary emotions and the Big Five theory and can have some ad hoc personality traits. Still, an Emotional NPC does not use GOAP, while Moody5 Agents exploit GOAP to achieve specific goals. In this latter case, personality and emotions can trigger re-planning when certain conditions are met.

1) GOAP with Dynamic Personality Bias: GOAP [28] is an AI technique that allows agents to plan (and revise when needed) a sequence of actions to reach a particular goal. The

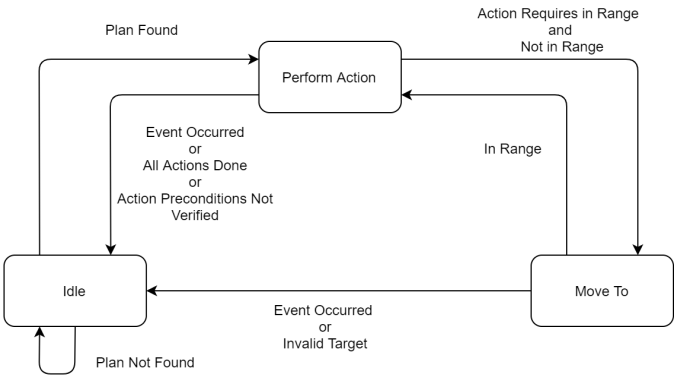

Fig. 2. The FSM used by Moody5 GOAP.

series of actions performed by the agent depends not only on the goal but also on the game's current state and the agent's state, thus producing more convincing behaviors [29]. Moody5 extends the GOAP structure of [10] by including the effect of personality traits and the emotional state of the agent (both can be "activated" according to specific game states). Actions have an execution cost, may alter the game state, and are represented by a set of key-value pairs. Pairs are used to define the preconditions and effects of each action and the goals of the NPCs. Moody5 GOAP is enhanced by a Finite State Machine - FSM (Fig. 2) composed by three states: *Idle*, *PerformAction* and *MoveTo*. When in the *Idle* state, the agent applies A* [30] to produce a queue containing the best sequence of actions that leads to the goal, considering the set of actions it can perform and the current state of the world. If it finds a feasible plan, the agent tries to perform the actions.

To handle interactions with the environment, Moody5 extends Unity's Environment Query System. Each personality trait "uses" a set of tests to assess events occurring in the game world within the agent's vision range, thus allowing to detect the presence of objects to which some specific "tag" is associated, detect collisions, calculate the distance between the agent and a target, and so on. The result of tests (the sum of numeric values normalized in $[0, 1]$) may impact the cost of an action, the actions that the agent can perform, the NPCs goals, or the cost of the path to reach a target, thus affecting the behavior and the emotions of the agent.

2) The Big Five Theory in Moody5: In Moody5, each Big Five values is modeled by an integer between -1 and 1, thus indicating whether a certain trait is positive, negative, or not active. In particular, they measure:

- **Agreeableness:** how much someone values getting along with others (friendly/compassionate vs. critical/rational)
- **Openness to experience:** appreciation for art, emotion, adventure, unusual ideas, imagination, curiosity, and variety of experiences (inventive/curious vs. consistent/cautious)
- **Extraversion:** breadth of activities (as opposed to depth), surgency from external activity/situations, and energy creation from external means (outgoing/energetic vs. solitary/reserved)
- **Neuroticism:** the level of emotional stability of an individual, hence the tendency to experience negative emotions, such as anger, anxiety, or depression (sensitive/nervous vs. resilient/confident)
- **Conscientiousness:** tendency to display self-discipline, act dutifully, and strive for achievement against measures or outside expectations (efficient/organized vs. extravagant/careless).

The behavior of a Moody5 Agent changes according to the values assumed by these five factors. The impact that each of them has is inspired by the work of Shirvani & Ware [9]. Moreover, the concepts of *interaction* and *consent* have been attached to each action. Respectively they indicate that action requires the participation of other NPCs and whether or not they are in favor of performing the action. Table I shows the contribution of each Big Five trait. The variation in the action cost is defined by a weighted variable, between -1 and 1, considering the big five traits that impact that action cost.

3) Emotions in Moody5: The mood of an agent is defined by a subset of Ekman's primary emotions: *joy*, *sadness*, *fear*, *anger*, and *disgust*. We excluded *surprise* since it is a short-term mood that usually precedes the surge of another emotion [27]; hence it would have been hardly noticeable in an agent for a video game. Additionally, a *neutral* mood has been added to primary emotions to indicate when an NPC is not affected by any particular mood. For each mood, we have defined an activation threshold and an *intensity value* (between 0 and 10). The intensity value of an emotion increases when certain events occur. An event is generated when certain game states are met, such as interaction through dialogues, something triggering a particular trait, or specific situations in the plot. Each event may impact the NPC's mood through an emotional reaction represented by an increase in the mood intensity: a "neutral" NPC will transition to a state of emotion when the intensity exceeds the related activation threshold. The emotional state will remain active for a predefined amount of time, during which no other emotions can be triggered. Once the effect is over, the NPC's mood returns to a neutral state, resetting all intensity values for all the moods. The activation threshold is modified by Big Five traits that are related to interactions: neuroticism, extraversion, and agreeableness [1]. A positive trait of extraversion decreases the threshold for joy. A negative trait of agreeableness reduces the threshold for anger and disgust. A positive trait of neuroticism lowers the threshold for all the moods, representing emotional instability. Each threshold is decreased by 20% of the default value for each trait that affects it. In the same vein, thresholds will increase if we consider the inverse for the traits above.

4) Effect of ad hoc traits: The personality of Moody5 Agents can be further extended using specific *ad hoc traits*, which force an agent to enter an emotional state under certain circumstances. For example, because of a phobia, an agent with the ad hoc trait "arachnophobia" will get scared of seeing a spider. Furthermore, Emotional NPCs can have ad hoc traits, but they are used only during interactions with the player

TABLE I
INFLUENCE OF EACH BIG FIVE TRAIT ON THE AGENT BEHAVIOR.

Personality Trait	Influences	Negative Value	Positive Value
Agreeableness	Cost of actions requiring consent	Decreases cost of actions that do not have the consent of another NPC	Increases cost of actions that do not have the consent of another NPC
Openness to experience	Cost of actions that the agent is performing for the first time	Increases cost	Decreases cost
Extraversion	Cost of actions that require interaction	Increases cost	Decreases cost
Neuroticism	Modify emotion transitions threshold	Slow emotional state transition	Fast emotional state transition
Conscientiousness	Number of goals an agent accomplishes when a new one is assigned	Deletes the current goal and add the new one to the top of the queue.	Adds a new goal to the queue.

through dialogues or during specific events.

5) Impact of the agent's mood on its performance: In actual life, an individual emotional state is not neutral concerning how it performs a specific action (e.g., a sad individual act slower than a euphoric one). To simulate this aspect, we set a duration (in seconds) and a probability of success for each action. These values are sensitive to the emotional state of the agent: joy will double the likelihood of success and is activated when a goal is achieved; anger halves the probability of success; sadness doubles the duration of an action and is activated when a goal is not reached. Fear and disgust are exceptions because they are associated with ad hoc traits. If an ad hoc trait is triggered by an external event, the agent might enter one of those moods, interrupting the current action execution and starting to search for a new plan.

B. NPC Monitoring Interface

Verifying the correct functioning of a Moody5 Agent behavior becomes a non-trivial task since there are multiple factors to consider. To simplify this task, Moody5 provides an interface that monitors NPC behavior at runtime. It works even on a "project build", thus providing a more effective solution than the standard Unity3D console. In particular, it tracks ad hoc traits activated, Big Five aspects that influenced the choice of actions to achieve the current goal, the current intensity of each emotion and their activation threshold, execution bar, and the stopwatch of an action (allowing - for a Moody5 Agent - to monitor the duration of an action influenced by the current mood). Last but not least, through the interface, it is also possible to regulate the intensity of an emotion, thus allowing to observe its effects directly and fine-tune the gameplay.

C. Dialogue system & Story Event

In the RPG scenario that we envisioned, the player interacts with NPCs using multiple-choice dialogues (as often happens in RPGs). Each line selected by the player can impact the agent's emotional state and trigger an ad hoc trait. The change in the agent's mood is visually represented by a change in its facial expressions (represented by an emoticon hovering the NPC in our test scenario - see Fig. Fig.3, thus making the player aware that something is going on. To add dialogues to the game scenario, Moody5 implements an interface based on the Dialogue Graph Editor that we have developed starting from the Node Based Dialogue System[1]. In particular, we have redefined the dialogue nodes to manage the changes in an emotional state and the activation of traits. The editor allows the creation of multiple choices dialogues defined as acyclic graphs, where the nodes represent a single sentence and the edges the connections between successive sentences. Hence, in Moody5, a dialogue node consists of a sentence, up to four answers, and a mood. The transition between nodes is triggered based on the players' responses, consisting of a sentence, the triggering mood, and the ad hoc trait (if any) that will activate the mood. Moreover, NPCs can be emotionally moved by special "narrative modules" that modify the behavior of an NPC *without a direct interaction* with the game world (e.g., an incoming declaration of war could affect the mood of an agent). Narrative modules are composed of a specific event in the story, the NPC(s) involved ad hoc traits (if any), a particular mood affected by what is happening and its intensity value, and an optional actor (represented by another NPC). When the event occurs, an ad hoc trait, if indicated, is added to the traits list of each NPC involved, and the intensity value of the associated mood is increased. If an actor is specified, the event is told or triggered by it. In this case, too, the narration is created with the Dialogue Graph Editor. The Drama Manager module (see Fig.1) is in charge of carrying out the story events, including these special modules.

[1]Available at: https://github.com/merpheus-dev/NodeBasedDialogueSystem

IV. TESTING MOODY5

While testing Moody5, our main objective has been twofold: we needed to validate the usability and effectiveness of Moody5 for creating NPCs and evaluate the player experience while interacting with such agents. Therefore, the tests consisted of a two-step evaluation. In the first step, testers were asked to create an Emotional NPC and a Moody5 Agent to add ad hoc personality traits and create an "emotion-sensitive" dialogue. The second step focused on playing twice the same RPG-based test scenario. Between tests, we modified some Big Five values and ad hoc personality traits of the NPCs to allow the testers to perceive variations in the behavior of the NPCs. Testers were allowed to freely explore the environment, observe NPCs performing actions, and interact with them. Moreover, they were shown the use of the monitoring interface. In the end, testers were invited to fill out a questionnaire focused on collecting: demographic information and gaming habits, feedback on the plugin usability, and feedback on the gameplay experience. Unfortunately, due to the current COVID-19 pandemic, our testing has been relatively limited

since the safety restrictions made it impossible to collect a significant sample of people. Moreover, the testing sessions have been performed remotely using Discord since the lockdown was active during that period. Therefore, we have just collected enough data for a preliminary evaluation of our approach. We managed to involve a sample of 17 gamers and game designers (either working in the industry or specializing in game development), hence reasonably entitled to give sound opinions on the effectiveness of the tool both in terms of the design and the effectiveness of agents. We also involved a different group of 5 testers who were only gamers (hence they skipped the first phase of the test). All of them were volunteers, without any compensation.

A. Test Scenario description

The test scenario was inspired by the Harry Potter universe and implemented as a 2D environment with a three-quarter camera. Harry Potter has been selected since its main characters have very recognizable personalities, thus helping to reduce the bias when players had to notice a transition in their emotional state. Also, we have verified that all the testers know enough about both the Harry Potter universe and its main characters to judge their behavior correctly. The scenario's map was a grid of square tiles, a subset of which contained interactive objects used by NPCs as targets to perform specific actions. Testers were able to observe the mood of an NPC by activating the monitoring interface, thus comparing their perception with what was going on in the "mind" of the agent. Fig.3 is a screenshot of the scenario with the monitoring interface active, showing an extrovert, neurotic Moody5 Agent being scared because of the activation of an Arachnophobia ad hoc trait. As shown in the figure, the agent has to prepare a magic potion, and its related plan includes interacting with another character. Regardless, the chain of actions can be updated according to the agent's Big Five values fluctuation and its ad hoc traits. Last but not least, specific events were generated at regular time intervals with a predefined probability. Each event was randomly extracted from a list of available independent events and then removed. This helped to introduce variations in the behavior of agents. Testers freely explored the environment while using their character to attend a "potions class" that forced them to interact through dialogues with several NPCs. Dialogues could be used to: talk with an agent, assign a goal to a Moody5 Agent, or receive a mission the player had to fulfill to progress in the game. However, tasks were given only by NPCs in a neutral or happy emotional state (otherwise, the NPC refused to assign quests). Hence it was important for the player to interact with an NPC effectively and to be able to guess its emotional state.

B. Sample composition

The first questionnaire section evaluated the samples' demographics, regarding: gender, age, profession, time spent playing video games, and favorite game genres. Furthermore, we sought to understand the player's relation to the game and the story elements and their familiarity with the Big

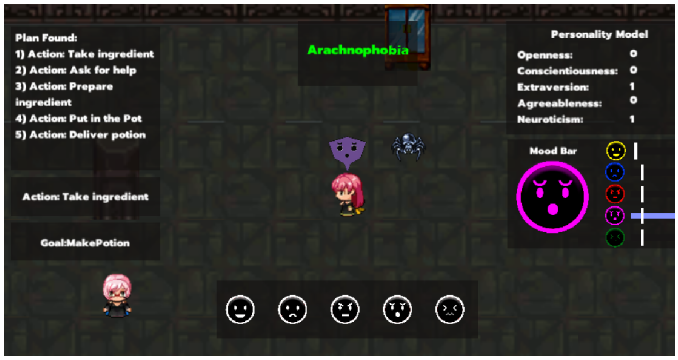

Fig. 3. Screenshot of test scenario with monitoring interface overlaid.

Five personality model and personality testing. As a matter of fact, understanding the basics of how a personality model works may have facilitated the overall understanding of the agent creation process. The sample included 50% of males, 36.4% of females, and 13.6% of individuals non-binary or that preferred not to answer. Most of the sample (72.7%) were 25 years or above, while only 27% was between 18 and 24. Computer science students specializing in game development were the 36%, while workers in the industry were about 40%. The 86.4% spends more than 5 hours a week playing video games, with a preference for RPG, puzzle, or adventure genres. The sample's primary motivation to play a game was the story (72.7%): 81.8% and 77.3% of respondents consider the story elements fundamental and with an impact on the game immersion, respectively. Regarding familiarity with personality-related aspects, 54.5% had previous knowledge of the Big Five personality traits, and 81.8% was interested in personality assessment methods. Therefore, the sample had the characteristics we needed to give us preliminary sensible, informed, and objective feedback.

C. Plugin's Usability Evaluation

To understand the possible bias introduced in the usability testing feedback, we investigated whether testers had previous experience with game engines and Artificial Intelligence for games. About 94.1% of the sample uses Unity3D and the 35.3% Unreal Engine. Moreover, 88.2% of them had experience with video game AI techniques, but only 5.8% with planning approaches, such as GOAP. Most of the evaluation in the questionnaires used Likert scales [31]: each question was defined as a statement, and respondents specified their level of agreement or disagreement on a symmetric scale, thus capturing the intensity of their feeling for that item. Table II shows the Likert items used to assess the plugin usability, while Fig.4 illustrates the Likert scale results in a diverged stacked bar chart.

As shown by Fig.4, the outcomes of this preliminary validation phase seem to demonstrate that the purpose of the plugin is clear (S2.1) and that the editor for agents creation helps define the structure of NPCs (S2.2). Additionally, even if testers struggled to add ad hoc personality traits (S2.4),

TABLE II
PLUGIN USABILITY QUESTIONNAIRES QUESTIONS ON THE FORM OF STATEMENTS (LIKERT ITEMS).

ID	Statements (Likert items)
S2.1	As a whole, the purpose of the plugin is clear.
S2.2	The agent creation interface is helpful.
S2.3	The agent creation interface is understandable.
S2.4	It is easy to add personality traits to agents.
S2.5	It is useful to generate story events that modify the emotional state of the NPC.
S2.6	The monitoring interface is understandable.
S2.7	The editor for generating dialogues through graphs are useful.
S2.8	The interface of a dialogue node is understandable.

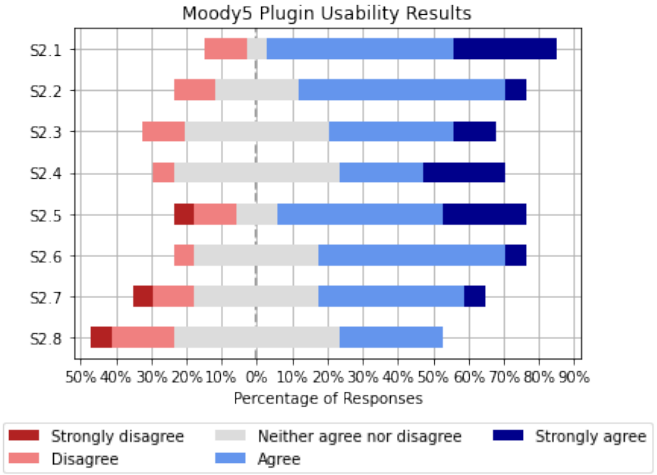

Fig. 4. Results in a Likert scale of the proposed statements on the plugin usability questionnaire (17 respondents).

they appreciated the mechanism to generate story events that modify emotional states (S2.5). Testers evaluated the dialogue editor as valuable for its purposes (S2.7), but they judged that its readability could be improved (S2.8).

We also investigated whether the testers would prefer to use the character monitoring interface instead of the standard Unity3D console for debugging agents' behavior. About 82% of them stated that they would use the monitoring interface instead.

D. Gameplay Experience Evaluation

In the second phase, we analyzed the scenario with the ampler sample of 22 testers, which spent - on average - at least 15 minutes playing. We aimed to understand the effect of NPCs' emotions and personalities on the overall gaming experience. Table III lists the Likert items used to assess the gameplay experience, while Fig.5 illustrates the results. Overall, testers agreed on the improvement of the replay value (S3.3) and the gameplay experience (S3.4).

Additionally, testers could deduce Big Five traits without using the monitoring interface (S3.2), but they had difficulties recognizing them through the NPCs' actions (S3.1). The most helpful feature used to differentiate the NPC behavior seems to be ad hoc traits (45.5%), followed by the Big Five (31.8%) and

TABLE III
GAMEPLAY EXPERIENCE QUESTIONNAIRES QUESTIONS ON THE FORM OF STATEMENTS (LIKERT ITEMS).

ID	Statements (Likert items)
S3.1	The NPCs' personality is recognizable by the actions it takes.
S3.2	I was able to deduce an agent's Big Five personality traits mainly without using the monitoring interface.
S3.3	The gaming experience has changed between both game tests.
S3.4	The NPCs' behavioral variability has improved my gameplay experience.

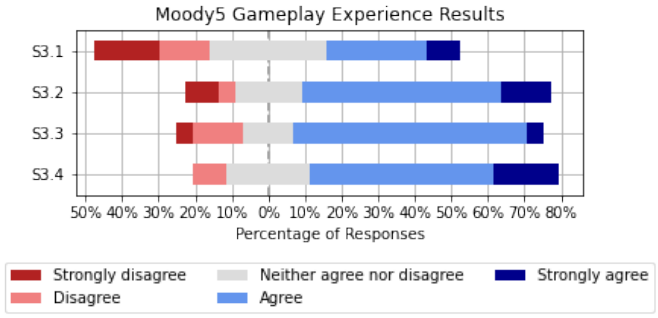

Fig. 5. Results in a Likert scale of the proposed statements on the gameplay experience questionnaire (22 respondents).

the emotional state (18.2%). Only 36.4% of testers considered the transition between emotions satisfactory, underlining that the number of emotion shifting was insufficient (36.4%) to be noticed appropriately. At the same time, equal percentages of the sample (13.6%) had dividing opinions on whether the duration of the emotional state should be increased or reduced.

We also evaluated the recognizability of each trait. Testers classified the difficulty of perceiving a personality trait in the following order (from the most difficult to the easier one): agreeableness (62.5%), openness to experience (37.5%), neuroticism (18.8%), extraversion (12.5%), conscientiousness (12.5%). We believe that the nonrecognition of agreeableness may derive from a too low rate of interactions with NPCs. To evaluate the replay value, we asked our testers if they would play the game multiple times to discover the different behaviors of the NPCs. Results showed that 81.8% would play at least twice, providing an initial indication that Moody5 agents might help increase replay value. Finally, we suspect that the testers who knew the Big Five model could better understand the variations in the agents behavior. In contrast, testers less interested in story aspects are less inclined to explore the different behaviors of the characters. Both these claims will be an object of future deeper investigation.

V. CONCLUSION AND FUTURE WORKS

This paper proposes Moody5, a plugin for Unity3D - a state-of-the-art game engine - that can be used to create personality-based NPCs in the context of narrative game worlds. Our main goal was to improve the gameplay experience in story-driven games by simulating - to a certain extent - the presence of a personality and the perception of emotions in NPCs. We defined a simplified personality model for agents - based on

Ekman's EMFACS and the Big Five traits - which influence the agent's decisions and behavior. Moreover, since GOAP governs the agent's actions, the impact of personality and emotion creates variations in the course of action NPCs follow to reach their goals. We then conducted a preliminary validation of Moody5 involving a sample of players and industry-related workers. The results obtained so far seem encouraging: testers seemed to agree on the enhancement of the gameplay experience: e.g., 81.8% of them said that they would play the scenario at least twice to explore the game's variability. However, the players were sometimes unable to correctly identify a specific personality trait, while they find easier to identify emotions. Our preliminary survey also demonstrated that Moody5 has quite good usability. We provided a clear idea of the plugin's features and an informative monitoring interface that was judged 82% of the times as a better solution than the standard Unity3D console. We are well aware that our work is still in its infancy and could benefit from further development and validation. We are planning, among other things, to develop a model for controlling the relationship between NPCs. This would improve the recognition of interaction personality traits, such as "agreeableness". Another possible future work could be the extension of the Drama Manager module to manage inter-relational story events and define a coherent narrative system. Finally, the dialogue editor could also be enhanced by defining different types of dialogue nodes and adding custom texts containing user-defined keywords.

The code, data, and complete questionnaires are available to interested scholars and practitioners on request.

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