AFFECT AND BELIEVABILITY IN GAME CHARACTERS – A REVIEW OF THE USE OF AFFECTIVE COMPUTING IN GAMES

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ABSTRACT

Virtual agents are important in many digital environments. Designing a character that highly engages users in terms of interaction is an intricate task constrained by many requirements. One aspect that has gained more attention recently is the effective dimension of the agent. Several studies have addressed the possibility of developing an affect-aware system for a better user experience. Particularly in games, including emotional and social features in NPCs adds depth to the characters, enriches interaction possibilities, and combined with the basic level of competence, creates a more appealing game. Design requirements for emotionally intelligent NPCs differ from general autonomous agents with the main goal being a stronger player-agent relationship as opposed to problem solving and goal assessment. Nevertheless, deploying an affective module into NPCs adds to the complexity of the architecture and constraints. In addition, using such composite NPC in games seems beyond current technology, despite some brave attempts. However, a MARPO-type modular architecture would seem a useful starting point for adding emotions.

1. INTRODUCTION

Artificial intelligence (AI) has been, and continues to be, one of the most popular fields for investigation in computer science. Alan Turing's question "can machines think" raised scientists curiosity and a tremendous amount of research has been conducted to investigate the possibility of a human-like machine. This includes various forms of software; chatbot, embodied conversational agents (ECA), virtual agents (VA), autonomous agents (AA), game companions, non-playing characters (NPC), extending to expressive and social robots. Relevant research in AI aims at creating intelligent virtual agents (IVA) and improving their behaviour to reach a human-like level. IVAs can increasingly be found in various virtual environments like intelligent learning, interactive storytelling, and games (Mott and Lester 2006; Aylett et al. 2009).

However, intelligence not only refers to how the machine can "think" or solve problems, but has been recently broadened to include emotional and social intelligence as well. Requiring the agents to act autonomously and intelligently with the user and with other agents in a manner similar to how a human would act entails them having to possess rich emotional and social behaviours (Dias and Paiva 2013). This involves how an agent perceives and expresses thoughts, how its surroundings influence its mood or emotional state, and how this affects its decision making and behavioural patterns.

Affective computing is the computer science field concerned with creating emotional machines; machines that can understand and express affect (Picard 1997; Hudlicka 2008; Yannakakis and Paiva 2014). It is evident that including a personality dimension in machine interaction increases the level of human-likeness and draws audience's attention more. In games for example, an NPC is exciting if it displays self-directed moves, and conveys its ability of smart decision making in gameplay. However, it would be more interesting if it had the ability to smile or laugh in response to the player's actions, or even argue with them, as opposed to just follow them around. In addition to the NPCs simulating humans in terms of life-likeness, intelligence, and empathy, adding an extra level of interaction to the game logic enables the NPCs to be more natural and perceive their environment with their emotions. This can enrich the sense of *believability* of the characters from the player's perspective (Mahmoud et al. 2014).

Games provide the perfect domain for affective interaction and understanding of the affective loop; systems that are able to elicit, detect, and respond to the emotions of users (Yannakakis and Paiva 2014). On one hand, users (players) are open to negative feelings like frustration, fear, or anger, making games the source of a broad spectrum of emotional responses and patterns, more than any HCI platform. On the other hand, by having emotions drive the design process for different genres, the player experience can be improved and even tailored to each player via affective-based interaction. In addition, affective-based interaction in serious games can significantly extend their applications and impact.

This paper discusses the need to incorporate an affective dimension into the design of intelligent game agents, focussing on how modelling emotions affect agent believability. Section 2 discusses emotionally intelligent systems and how affective computing fits into games. In section 3, believability criteria of VAs are investigated and design issues of believable NPCs are discussed. Section 4 reviews some frameworks that combine emotional models into agent architecture for games and other applications. Discussion and conclusions are presented in section 5.

2. EMOTIONALLY INTELLIGENT AGENTS

Recognising and reasoning about affect (Sollenberger and Singh 2012) enables the development of systems with higher intelligence (Gratch and Marsella 2003), enhanced user interfaces (Bickmore et al. 2007), and more effective learning environments (Marsella et al. 2000). A relatively recent development in *expressive AI* (Mateas 2001) is creating VAs that are capable of understanding users' affective states through social and emotional intelligence. This requires recognition of human emotions and the generation of associated affect and behaviour (Lisetti and Hudlicka 2014). Designing affect-based systems require addressing the following issues (Clavel et al. 2017):

- Adding emotional model(s) into the agent architecture.
- Defining the role of emotions in the decision making needed to obtain believable reactions.
- Assigning the generated emotion(s) to expressive behaviour(s).

A typical intelligent agent involves a means for collecting knowledge from its surroundings, a decision making mechanism, and a means for executing those decisions. Hence, the design of an emotionally aware system requires interoperable models between the sub-systems of affect detection and expression, as well as models of the relation between emotions and generated social functions (Clavel et al. 2017). According to (Lisetti and Hudlicka 2014), emotion-based architectures include a subset of the following components:

i. *Sensors*: must be able to show, to an appropriate context-based extent, the human emotional state, expressed in unimodal or multimodal cues. These include facial expressions, gestures, vocal intentions, sensorimotor cues, autonomic nervous system signals, and natural language. The agent captures and interprets these affective signals and translates them into the most probable affective state of the user.

ii. *Decision-making algorithms*: these differ based on which emotion theory, or combination of theories, is adopted in the architecture. The result of this process may influence the agent's affect state as well as its expression of emotion.

iii. *Actuators*: used to control anthropomorphic embodiments associated with affect modalities. In other words, for the agent to express its own affective state, emotions, and other signals influenced by that internal state, it must have some means like a 2D or 3D, text-based, or audio expressive channels.

Games are a natural application of affect leading to the emergence of affective games, or affect-aware games, and the need to deploy emotionally intelligent agents into games. In analogy, three elements of game design should be addressed (Hudlicka 2008):

- Sensing and recognition of players' emotions.
- Modelling emotions in game characters and user models representing the players.
- Tailoring the game responses in return by generating affective behaviour in characters and avatars, to enhance their realism and believability.

Adopting affective computing principles directly into games demands that players be monitored and their emotions identified and contributed to gameplay. Game controllers have to be equipped with multimodal sensors to collect player's physiological and social signals, and the game logic has to include emotion modelling and recognition algorithms. In addition, the resulting emotion must alter the game content somehow to elicit more emotions in the player. Implementing a fully closed affective loop in games seems to be out of reach with current technology and perspectives, although some major game companies began working on adding affect to their productions (Emotional Video Games 2011). Therefore, designers usually address affect through an open loop via level design, game character, and gameplay. (Yannakakis and Paiva 2014; Rosenkind 2015; Warpefelt 2016) include examples and analysis of some commercial games that incorporate affect as part of their gameplay or characters.

It is important to note here that for a game character, the intelligent agent model should not require producing a "perfect" agent, but rather, for better human resemblance and higher believability, it is more natural to have the flaws and dysfunctionalities of the human affect phenomena incorporated into the model (Lisetti and Hudlicka 2014). For example, an agent may go the wrong way if it is experiencing a state of "confusion" or "stubbornness". Also if used for training purposes, goal conflicts, neuroticism, and bad decisions, may be a requirement for more realistic scenarios. Moreover, modelling more aspects of humanness adds depth and complexity to the agent's character, which in turn has a positive influence on the audience's engagement and experience. Complex behaviour makes observers assume complex internal processes. Hence, a correlation is inferred between perceived emergence and suspension of disbelief and the more the agent appears complex to observers, the more they perceive it as believable. This means the agent design must focus on creating diverse complex behaviour and avoid repetitive robotic ones (Rosenkind 2015).

In essence, for interactive games, the involved computer character is required to be believable to make the player willing to suspend disbelief, regardless of the degree of realism. This involves characters who are naturally presented with conflicts and challenges, are flawed, or not at their best (Lisetti and Hudlicka 2014). In the next section, the term believability is discussed in more detail, along with the challeneges of designing believable NPCs.

3. AFFECT AND BELIEVABILITY DESIGN

Dating back to the early work of animation, literature, and films, the term believability was described by (Bates 1994) as the illusion of life that permits suspension of disbelief. People are lead to believe that the characters they view/read/interact with are real in the sense that they do not reject the story because they disbelieve what they perceive (Lee and Heeter 2015). However, for digital games, characters do not necessarily have to be credible or reasonable for the players to suspend disbelief. Table 1 summarises believability principals collected from the literature and it is clear how affective dimensions comprise a main asset of a believable character. Whereas designing traditional AI is concerned with competence and objective assessment, believable agent design involves personality, audience perception, and characters, with a basic level of competence (Mataes 1999).

Apart from a few, most studies acknowledge that agents possessing the suggested qualities are desirable for making players interact with them more. Nevertheless, some NPCs are required to appear more or less advanced than others, and hence may only need to possess a combination of qualities depending on their role and functions in the game. Moreover, these qualities must be incorporated into a narrative to make sense and appear realistic. This again, depends on the game genre and what type of NPC the player is interacting with. It is pointed out that NPCs should elicit some form of affordances to be persuasive (Warpfelt 2015). In essence, the appearance, behaviour, and affordances of the NPCs should imply to the player what to expect and how to interact with them, all of which, contribute to the believability and playing experience. Also, (Rosenkind 2015) claims that virtual agent believability should focus on the perception of the character. In other words, a distinction is to be made between player believability, and character believability (Livingstone 2006).

3.1 AI and Believable NPCs

Player believability assumes the user is aware of the character not being real and there is no illusion of life or suspension of disbelief to break (Togelius et al. 2013). However, the observer should be convinced that the autonomous agent is being navigated by a human controller. In this context, design issues are often more concerned with traditional AI goals of planning and behaviour modelling, as opposed to adding personality to characters.

The majority of current AI is scripted, using finite state machines for decision making, and standard search and navigation algorithms. For commercial games, the most commonly used method for behaviour modelling is rule-based approaches (Ji and Ma 2014; Akbar et al. 2015; Feng and Tan 2016), which do not allow NPCs to evolve and capture new knowledge, and ignore the possibility of developing adaptive agents and more emergent behaviour. Though it has been pointed out how challenging it can be for developers to introduce academic AI into games development, there have been some trials that make use of academic research in games. This includes the use of behaviour trees in Halo 2 (Bungie Studios 2004), goal oriented action planner (GOAP) in F.E.A.R. (Monolith Productions 2005), multi-layered hierarchical task network (HTN) planner in Killzone 2 (Guerrilla Games 2009), evolutionary algorithms (Harrington et al. 2014), and Adaptive Resonance Theory (ART) networks (Feng and Tan 2016). Some tournaments exist for encouraging and testing new efficient approaches for player believability, like the 2k BotPrize (Hingston 2010) and the Mario AI Championship (Togelius et al. 2013). It is worth mentioning that player experience and familiarity with the game affect their perceived believability, as their knowledge of the “usual” AI patterns will vary.

3.2 Character Believability

Character believability requires a high degree of realism in various features; appearance, behaviour patterns, and dialogue (Togelius et al. 2013). With the huge advances in graphics and animation, the degree of visual realism of NPCs can reach impressive levels. However, this is often hindered by the rather simpler implementation of a behaviour model for the agent, which is often based on one of the techniques mentioned above. This certainly affects the believability of the agent and renders the game experience disappointing (Kersjes and Spronck 2016).

Problems of NPCs usually lie in their lack of convincing social and emotional behaviour raising the need for a robust affect module within the agent’s architecture. Developing an integrated architecture would ideally require developing models for the theory of emotion, social relation, and behaviour, and combining the theories into an overall model (Lisetti and Hudlicka 2014). Ideally, it would be like adding an affect module to a MARPO agent (Laming 2008). This is a complex process and in practice, theories are often simplified and assumptions are made about the architecture to facilitate implementation. Adding more dimensions to the components, e.g. modelling more emotions, deeper personality, complex planners and behaviour patterns, clearly adds more depth to the character as much as complexity to the system. Perhaps if such a model exists, it will be hindered by current technology limitations. A good example of what future emotional characters in games might look like is the Milo prototype that was presented by Peter Molyneux and Lionhead Studios at TEDGlobal in August 2010. The AI details were not revealed but simulation seemed to have a psychological profile evident in some “boyish” actions from Milo (Meet Milo 2010).

Table 1: Believability Requirements for Virtual Agents

(Mateas 1999)	(Loyall 1997)	(Gomes et al. 2013)	(Lee and Heeter 2015)	(Bogdanovych et al 2016)
Personality	**Illusion of life:**	Awareness	Appearance and behaviour	Appearance
Emotion	Appearance of goals	Behaviour Understandability	Personality	Personality
Self-motivation	Concurrent pursuit of goals	Personality	Goals	Emotional state
Change	Parallel actions	Visual impact	Emotions	Liveness
Social relationships	Reactive/responsive	Predictability	Social relations	Illusion of life
Illusion of life	Situated	Behaviour coherence		Consistency
	Resource bounded	Change with experience		Change
	Exists in social context	Social expressiveness		Social relationship
	Broadly capable	Emotional expressiveness		Awareness believability
	Well integrated			Environment awareness
				Self-awareness
				Interaction awareness

Although combining all the discussed requirements into a single model may seem more complex than achievable, there are various attempts towards emotionally believable characters. In section 4, we present some existing architectures that combine affective modules into the agent's design for better social interaction, and hence, more believable behaviour.

3.3 Believability Assessment

Finding a standard way to evaluate the believability of a game character can be problematic as no unified definition or set of qualities exist for it. Even with a clear set of believability requirements, there is no way to determine the weight of each quality to the overall character believability. What can be evaluated to an extent are players' opinions regarding the character's behaviour, interaction, the relationship it managed to forge with them, and the whole experience.

Player experience can be measured through subjective, objective, or gameplay-based approaches (Yannakakis et al. 2008; Mandryk et al. 2006; Asteriadis et al. 2008; Pedersen et al. 2010). It is also argued that in many cases, it is better to judge the character's believability from a third-person perspective (Togelius et al. 2013). In addition, (Rosenkind 2015) suggests combining traditional user experience research techniques from HCI, with the believability metrics mentioned earlier. It also acknowledges the fact that no research in game testing focusses on game context or investigates the inconsistency between agents design and player perception. This is opposed to testing user experience in games which have been addressed in several studies, none of which however, used believability metrics to evaluate player-NPC interaction. For the game industry, combining performance metrics (gameplay data) with self-reported metrics (user responses) have become popular (Rosenkind 2015)

It is worth noting that the majority of the surveyed models presented in section 4 used questionnaires of Likert scales to assess the tested qualities by asking the players about how "they felt" during the experiment, or compare the character to its base version.

4. AFFECT-AWARE VAs AND NPCs

Several research efforts attempted to incorporate emotional and social aspects into virtual agents and NPC design. Such models are preferred to scripted agents that cannot change or adapt to surrounding events.

Koko (Sollenberger and Singh 2012) is a service-oriented middleware that helps incorporate affect recognition into games. It is intended to be used as an extension to existing game/applications that seek to recognise human emotions. Koko offer a domain independent framework for modelling human emotions but can be used to model NPC emotions as well. It was used in BooST mobile application and the educational game Treasure Hunt.

The Social Signal Interpretation (SSI) framework (Wagner at al. 2013) is a tool for recording and recognising human's social and affective signals. It complements existing tools and offers an online recognition system from multiple modalities. Its interface allows for interoperability and support of various sensing devices and was used in several systems like E-Tree (Gilroy et al. 2008), and EmoEmma (Cavazza et al. 2009). Again, this is an emotion recognition system, hence can be used in combination with other believability systems as an input module.

An architecture that allows Interpersonal Emotional Regulation (IER) (Dias and Paiva 2013) incorporates three emotional intelligent skills into agents: generation and expression, reasoning, and regulating emotions. The agent determines the relevance of an event, models social attractions to the surroundings, and uses a planner to create goals and actions to achieve them through two types of strategies. The suggested model is claimed to be generic and flexible to be adapted to different contexts. Tested in a scenario of Neverwinter Nights 2 (Obsidian Entertainment 2006), players perceived the NPCs employed with the model as friendlier. Authors state that this experiment did not validate the proposed model, but rather proved that employing emotion regulation helps establish friendship relations with NPCs in different ways.

The Virtual Human Toolkit (Hartholt et al. 2013) is a collection of modules, tools, and libraries, integrated into a framework and open architecture for creating ECAs. It includes speech recognition, natural language understanding, audiovisual sensing, and nonverbal behaviour understanding. These inputs combined with the internal state enables the agent to create communicative input. The toolkit is released to the research community and is considered one of the earliest attempts to integrate human simulated capabilities into a larger framework. Although authors acknowledge the toolkit is capable of creating several types of VA, like QA characters and virtual interviewers, no experiments were presented in this regard. Also the use of a rule-based planner seems too simple.

The work by (Mahmoud et al. 2014) tried to mimic human behaviour by proposing a visual perception system for NPCs along with short term memory. This limits the amount of information the NPCs have access to about the environment, resembling the restricted human capabilities of perceiving their surroundings, which influence the agent's behaviour with "natural" uncertainty, reluctance, and reasoning. The strategic planning component was implemented using a hierarchical task network (HTN). The system generated the perfect plan for handling a car crash scenario, hence may not be suitable for game characters according to the discussed believability criteria. Moreover, it has been tested on only a single scenario, and although the system could come up with an ideal plan in real time, a change in the environment can cause some conditions to cease; affecting the planning process. Authors argue that providing more methods and operators may eventually generate the perfect plan successfully. The study did not assess the believability of the NPC following the proposed system.

The FAtiMA (Fearnot Affective Mind Architecture) (Dias et al. 2014) is a generic and flexible architecture for emotional agents, with what the authors believe is the minimum set of functionality. It enables incorporating several appraisal theories. The framework has two main components, the core and the modules. The core layer does not commit to any particular method used, and behaviour is added by implementing desired functionalities as components on the core. All components are designed to be interchangeable and loosely coupled. The core architecture has two processes: the *appraisal derivation* evaluates the relevance of the event to the agent and determines a set of appraisal variables (likeness, desirability, etc.), and the *affect derivation* combines the appraisal variables with appraisal theory to produce an affective state (mood, emotion). FAtiMA is claimed to be the first step in creating standards in emotion modelling. It was compared against similar systems like FeelMe (Broekens and DeGroot 2004) and the EMA model (Marsella and Gratch 2009) but only on a theoretical basis. No experiments or scenario tests were presented.

The Emotionally Realistic Social Game Agent (ERiSA) (Chowanda et al. 2014) exploits the player-agent relationship in terms of social signals (facial expressions, gestures, and voice), personality, and emotions, to propose a modular framework. It includes sensing, interpretation, behaviour generation, and game components. A generic formulation of action selection rules is presented and modelling agent personality was based on the OCEAN model (Saucier and Goldberg 1996). The social relations were based on two variables; *like* (depends on emotion of the agent towards the player) and *know* (affected by how many times the agent met the player). Emotions were modelled as a function of personality and social relations over an average of events. Using two SEMAINE characters (Schröder 2010; McKeown et al. 2012), ERiSA was tested in The Smile Game (Chowanda et al. 2015), where a player's objective is making their opponent laugh with "attacks" of jokes and facial expressions. Authors claim the game to be a good case study since gameplay is simple yet elicits rich nonverbal interaction between player and agent. All studies showed that the virtual agents were reasonably good in evaluating facial expressions, albeit a little slow. This is the first integrated framework for social and emotional game agents. Existing (previous) frameworks proposed a generic model for IVA, but none presented a model for relationships between player and agent and used it to generate behaviour rules. The behaviour generation process is dependent on player emotions from video input stream and the social relation between him and the agent, based on their familiarity with each other. Also, machine learning could be used to learn new attack patterns and store them for future use. Furthermore, ERiSA was investigated and evaluated in a RPG scenario (Chowanda et al. 2016). The experiments aimed at testing the effect of having a game agent capable of perceiving and exhibiting emotions, supported with the ability to develop simple social relations over time. Participants had to complete a short Skyrim quest, and results showed that players were more emotionally engaged and immersed in the game with the NPC employing ERiSA as opposed to its base version.

The work by (Kersjes and Spronck 2016) adapts a simplified version of personality model of (Ochs et al. 2009), omitting attitude and social relations and describing the agent only by its personality and emotional state. An agent's personality affects the intensity of event-triggered emotion, and hence its emotional state, which in turn, determines its expression of behaviour. It was tested with a game in which a human player interacts with three NPC; extrovert, neurotic, and neutral. It concluded that players can indeed distinguish personality difference based on facial expression; hence, adopting a personality model can help game developers create a high variety of virtual characters. The study only used facial expression to express agent's behaviour after events, and with only two sets of emotions. It may be true that it is over-simplified, but at least this work partially verified Ochs model, which was purely theoretical and was never tested. It did not address the limitations of Ochs though.

The General-purpose Intelligent Affective Agent Architecture (GenAI3) (Alfonso et al. 2017) describes a Belief-Desire-Intention (BDI) agent architecture (Rao and Georgeff 1995). This is an extension to Jason architecture (Bordini, and Hübner 2005) but does not commit to a specific cognitive theory, so different emotional and behavioural models can be implemented through it. Hence, it is considered interoperable with the applications adopting Jason, and suitable for a variable range of scenarios.

A CAD (contempt, anger, and disgust) model is proposed in (Dastani and Pankov 2017) for specifying what motivated such emotions and the behaviour they elicit when established. Integrated to a moral emotion model of BDI, this architecture houses the process of emotional generation in agents and the goals and behaviour that follow in a unified model.

5. DISCUSSION

5.1 About the Models in Section 4

Design: The majority of the reviewed frameworks focus on computationally modelling affect and behaviour based on an emotion theory (the most common is the appraisal model), and associate the resulting affects with a limited set of behaviours. It shows that the challenges mostly lie in the system complexity and response time, hence, the frameworks are largely empirical and research-oriented. There is little evidence of incorporating AI techniques in implementing the affective module and it is mostly a direct association between emotion and behaviour. Utilising machine learning in affective computing for AV design can improve its believability. For example, allowing the NPC to learn the most suitable emotion to express or the appropriate behaviour in certain situations.

Test: A number of models were never tested in actual interactive environments. When tested, a short game/interactive scenario is implemented and tailored specifically for the developed architecture. However, no details are often given about the behaviour control process or the techniques used to execute it. Usually a set of rules, a game prototype, or a game engine, is used to execute the behaviour, and were specifically designed for a certain genre or specific scenario. The majority of tests were always limited in context and audience (even non-gamer participants were from the same domain).

Assessment: Measuring *perceived* believability is the most common, which is based purely on agent's behaviour. All evaluations of character believability were questionnaires.

5.2 Conclusion

Human players usually prefer playing with, or against, other human players rather than AI agents due to the unpredictability in human gameplay behaviour (Mahmoud et al. 2014; Miles and Tashakkori 2009). Repetitive and predictable behaviour makes games less challenging and discourages players. The design of a computer agent often focusses on perfecting the intellectual abilities of the agent which may not be the most representative attribute for its believability. A 'God-like' behaviour may also be considered non-believable (Mahmoud et al. 2014). Recently, an evident shift in research tends to incorporate affective models into agents' architectures to achieve a more human-like performance.

Creating machines that can mimic human beings involves modelling traits that make us human. This largely means re-creating human interactive abilities by modelling sensing, interpretation, thinking, emotions, reactions, planning, memory, mood, personality, to mention a few. The considerable amount of resources and specialised knowledge required for mimicking the essences of human interaction is extensive. In addition, the above capabilities should not be developed in isolation, but rather, integrated into a larger system, and further into systems of systems, presenting complexity and dependency in research and implementation (Wagner at al. 2013).

This clearly is cumbersome, and the aim to improve the agent's ability leads to extremely complex systems. The work in (Warpefelt 2016) used the GAM (Warpefelt et al. 2013) to create an NPC model that describes the minimum required complexity to successfully implement a believable version for this type of NPC. Even with the appropriate knowledge and resources, an intelligent believable system can still be complex, costly to develop, lack a standard framework, and the design principles are often domain specific and difficult to generalise (Wagner at al. 2013). This is why existing research often attempts to simplify the architecture to model only a subset of qualities, or have separate modules with few features. Moreover, very few of the existing frameworks address the role of appearance in the believability of the character, which often leads to participants getting confused about the agent's expressions.

An issue often neglected in the research of VAs is the ethical implications of implementing affect in artificial systems. Mostly, persuasive agents should be able to reason about their own actions from an ethical perspective because the possibility of analysing users' emotions facilitates manipulating their affective state, especially for the elderly and underage (Clavel et al. 2017). However, this may not be the case for games, particularly when the character's questionable ethical profile is part of its role.

It is probably too ambitious for an agent to possess all suggested believability qualities at once. Moreover, it is clear that there is overlap between several qualities. In some experiments, audiences tended to miss certain qualities during testing due to confusion or unawareness. This inclined the experiments to isolate the tested qualities to be properly presented allowing relevant valid feedback. As for test settings, the most promising scenario was short game quests where the NPC possessed two emotions, and could forge social relations with players through four actions (Chowanda et al. 2016). This shows that, with sufficient technology and resources, emotionally intelligent and believable game characters are attainable.

Research in believable agents applies as well to the field of robotics, and expressive and social robots are gaining popularity on both research and consumer levels in fields like entertainment, healthcare and education.

Perhaps it is true what the discussion above indicates; production level is still not there yet. However, incorporating emotions into a MARPO-type modular structure seems the most reasonable answer to creating an AI architecture for an intelligent agent..

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