

# Modeling Artificial Personalities through the Expression of Emotions in Narrative Games

Master thesis

**Marijn Otte**

4222695

Thesis committee:

Dr. ir. A.R. Bidarra

Dr. ir. D.J. Broekens

Dr. ir. I.M.T. Swartjes

Prof. dr. C.M. Jonker



Interactive Intelligence Group  
Faculty of Electrical Engineering, Mathematics and  
Computer Science  
Delft University of Technology  
Netherlands  
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## **Abstract**

Personality modeling is important in order to create character variation in games. Character variation favors replayability and is an important aspect of game design. The effect of artificial personalities through the expression of emotions is evaluated in this research. To do so, a prototype game is developed in the context of training in bad news conversations. Replayability through character modeling is important in a game in which people can train to deliver bad news. By training with multiple personalities one can learn to deal with the different reactions that people can give. In this thesis, the effect of artificial personalities through the expression of emotions on the replayability of the game, believability of the non-playing character and immersion of the player is researched. It is expected that artificial personalities have a positive effect on the replayability of the game and believability of the non-playing character, but not on the immersion of the player. Experiments show that there is a positive trend in the replayability of the game and the believability of the non-playing character.

# 1 Introduction

Serious gaming is a sub-field in Artificial Intelligence (AI). According to Alvarez and Djaouti [1], a serious game is a game that targets a market other than only entertainment: defence, training, education, health, commerce or communication. In many serious games a virtual world is created. In this virtual world one or more virtual characters (VCs, hereafter non-playing characters or NPCs) participate. Making NPCs look like humans in terms of behavior is challenging, but meanwhile important because it favors the immersion of the player of the game [2].

Creating behavioral characters is important in a game in which the purpose is to train the player in delivering bad news. Bad news conversations are conversations in which one person, the bad news deliverer (BND), has to give bad news to another person, the bad news receiver (BNR). The approach that the BND uses to deliver the bad news influence the behavior and emotions of the BNR. Emotions have an important role in bad news conversations [3]. A BND falling into a pitfall (pitfalls will be explained in section 2.6) at the beginning of the conversation has an impact on the emotions of the BNR in the rest of the conversation.

Many people that have to give bad news are not sufficiently skilled at doing so [4]. This results in two major problems. First, the inability to hold bad news conversations causes chronic stress, burnout and low work performance in the BND [5]. Second, the BNR ends up feeling more negative than necessary about both the conversation as well as the BND [6].

Training bad news delivery is possible and very important [7]. Books exist with tips and tricks on how to approach a bad news conversation [8, 9], but by practicing bad news conversations the BND will learn how to bring these tips and tricks into practice. Real-life training is one of the best ways to train bad news delivery [7]. However, practicing with real people is time consuming and expensive. To overcome this practical concern a serious game in which the BND will be trained in delivering bad news is developed. By creating different characters with different personalities more variation is created in NPC behavior. In the game that is developed for this research, different personalities are created through emotion modeling. A personality factor is added upon an emotion model and influences the emotion intensities of the NPC. The effect of personality through the intensity of emotions on the believability of the NPC, replayability of the game and immersion of the player is being researched.

# 2 Related Work

This section describes related work done on different aspects relevant to this research. At first, different aspects that determine the behavior of the NPC are described: emotion, personality, coping and the dialog. Next, an overview of the concepts of believability, replayability and immersion will be given. These are three characteristics that are important in creating gaming experience. This is followed by different aspects of bad news conversations in general. What is so difficult about breaking bad news, and how does a training look like in which a manager is trained to deliver bad news? To end with, research that is done on games to train in bad news conversations is described.

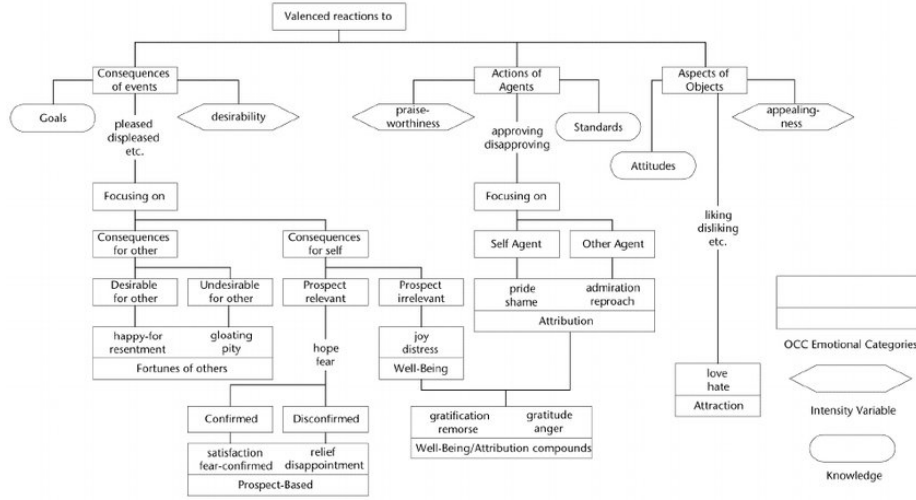


Figure 1: The OCC Model

## 2.1 Emotion

Emotion has no generally accepted definition. Emotions are loosely regarded as a reaction to personally significant events where the reaction may include biological/physiological arousal, changes in cognitive processes, behavioural/social/motor expression, action tendencies and subjective labelling of these feelings [10]. There are categorical models, dimensional models and appraisal models of emotion.

Categorical models state that each human has a discrete set of basic emotions that are cross-culturally recognizable from facial expressions and biological processes [11]. An example of a categorical model is the model proposed by Ekman [12]. This model uses six different basic emotions: anger, fear, joy, disgust, sadness and surprise. An advantage of this model is that is very easy to translate these emotions into facial expressions using the Facial Action Coding System (FACS) [13].

Dimensional models assume the existence of two or more major dimensions which are able to describe different emotions. In this type of model a person is in exactly one affective state at any moment, and the space of possible core affective states is characterized in terms of broad, continuous dimensions [14]. For example, Whissell created a dictionary of affect in language [15]. This dictionary provides a list of emotional terms in which each term is described along the dimensions of activation (arousal) and evaluation (pleasantness). Russell proposed a framework consisting of two dimensions: arousal-sleep and pleasure-displeasure [16].

Appraisal models evaluate needs, beliefs, goals, concerns and environmental demands that might occur consciously or unconsciously. This evaluation results in an emotional response. This type of model has become a very attractive approach in the domain of emotional psychology. The OCC model [17], an appraisal theory of emotions, is found to be the most used in computational models. An overview of this model can be found in Figure 1.

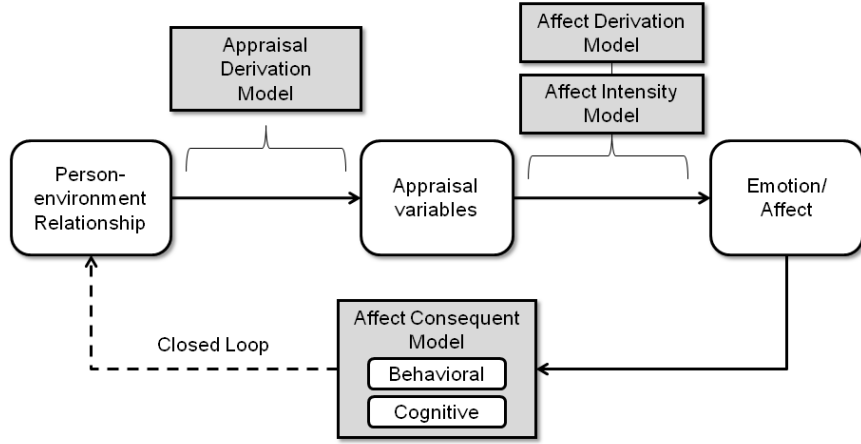


Figure 2: A component model view of computational appraisal models

**Emotion in NPCs** Emotion is part of many computational models that are developed for agent based modeling. Marsella et al. [14] analyzed different computational models of emotion. They created an idealized component appraisal architecture consisting of a set of linked component models. This architecture can be found in figure 2. In this architecture information flows in a cycle. Such a cyclic information flow is proposed by multiple appraisal theorists, e.g. [18]. Each stage can be represented by a model that represents or transforms state information relevant to emotion-processing. In the person-environment relationship stage the agent can derive the relationship between external events and the beliefs, desires and intentions of the agent. These relationships are transformed into a set of appraisal variables in the appraisal-derivation model. The appraisal variables correspond to the set of specific judgments that the agent can use to produce different emotional responses. These variables can be e.g. the variables proposed in the OCC model. The affect-derivation model maps between these appraisal variables and an affective state, and specifies how an individual will react emotionally once a pattern of appraisals has been determined. The affect-intensity model specifies the strength of the emotional response resulting from a specific appraisal.

**FAtiMA** FAtiMA (Fearnot AffecTive Mind Architecture) is an agent architecture designed to use emotions and personality to influence the agent’s behavior [19]. The core of this model is a template that generally defines how the agent architecture works. Different components are added in order to add functionality. These components can provide specific implementations for the generic functions defined in the core. An overview of the core can be found in figure 3. An agent is able to receive different perceptions from the environment. These perceptions are used to update the memory of the agent and to trigger the appraisal process. The result of the appraisal process is stored in the affective state, and later used to influence the action selection processes resulting in an action performed by the agent.

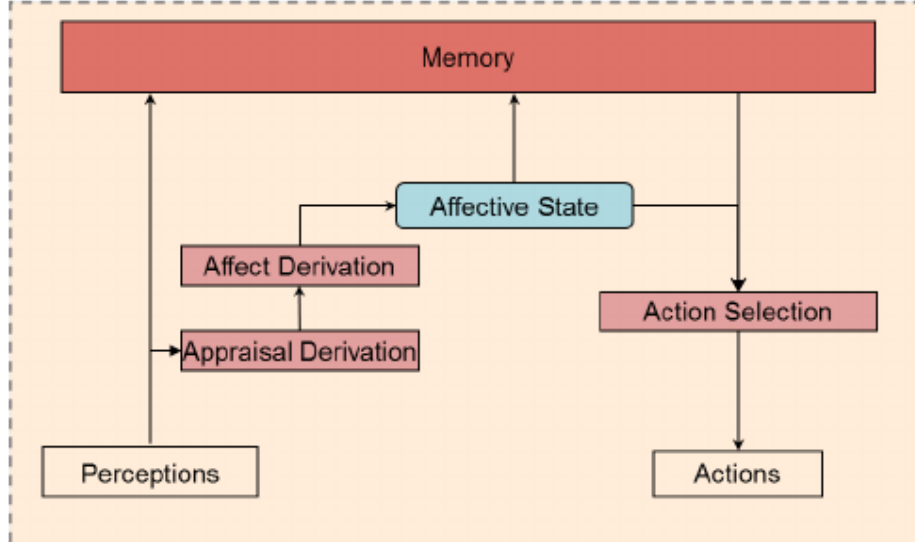


Figure 3: FAtiMA Core Architecture

**EMA** Several complicated frameworks have been generated with multiple levels of sophistication, for example fast and automatic vs slow and deliberate appraisals. According to Marsella and Gratch [20] these multi-level theories are unnecessarily complicate by conflating appraisal and inference. Therefore, Marsella and Gratch have developed EMA (for EMotion and Adaption)[20], a framework for exploring and explaining emotion dynamics in which appraisal and inference are distinct processes. The relations between appraisal, emotion, coping and cognitive processes assumed in this research are shown in figure 4.

**ALMA** ALMA (A Layered Model of Affect) [21] integrates three major affective characteristics: emotions, mood and personality that cover short, medium and long term affect. It makes use of the FFM model (explained later) for personality modeling and the OCC model for emotion modeling. These models are mapped in the pleasure, arousal and dominance (PAD) space to represent moods.

**GAMYGDALA** GAMYGDALA [22] is an emotion appraisal engine for games. It enables game developers to easily add emotions to their NPC. GAMYGDALA is easy to use, AI independent and easily pluggable. In GAMYGDALA a game designer needs to define different goals for an agent that needs simulated emotion. Next, the game designer can define which events are relevant for each goal. When an event occurs, GAMYGDALA appraises this event and outputs the most plausible emotion(s) based on the OCC model and the goals of the agent. Eventually, GAMYGDALA will be used as engine for this research.

## 2.2 Personality

According to Corr and Matthews [23], personality is the characteristic set of behaviors, cognitions and emotional patterns that evolve from biological and



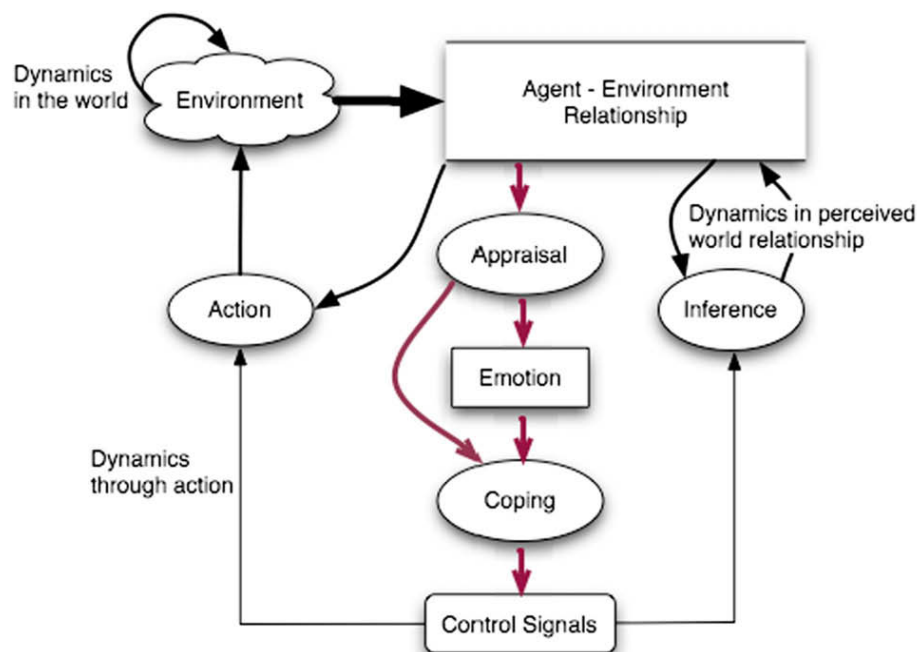


Figure 4: An illustration of the theoretical assumption concerning the relationship between appraisal, emotion, coping and cognition, and the sources of dynamics that result proposed by Marsella and Gratch [20].

environmental factors. Personality is related to emotion. A helpful analogy is to consider that personality is to emotion as climate is to weather. That is, what one expects is personality, what one observes at any particular moment is emotion[24].

Eysenck was one of the first who proposed a personality model [25]. His model is based on physiology and genetics, believing that personality traits are inherited. His model consisted of two dimensions: neuroticism and extraversion. Later he added psychoticism as a third dimension.

The work of Eysenck led to the modern five-factor (FFM) model of personality. FFM is most prominent to measure personality traits [26]. It is a hierarchical organization of personality traits in terms of five basic dimensions: Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness to Experience [27]. An explanation of these five factors can be found in Table 1.

**Personality in NPCs** By giving the NPC a personality trainees can try different approaches in communicating with the various simulated personalities, experience the outcomes, and adjust their strategies accordingly [28].

FFM is the current state of the art model in personality modeling [27]. A benefit of this model is that each factor fits to one or multiple coping strategies (see section 2.3 for coping strategies) [29]. Coping strategies can be implemented in the behavior of a NPC with a certain personality. FFM is suitable for character creation in NPCs as this has been done multiple times in previous work [28, 30, 31, 32]. Many models that used FFM to model the personality did not use all five factors in their model. Often, only agreeableness and extraversion were modeled [28, 31, 33]. Agreeableness and extraversion are important when dealing with social relationships [31]. Sometimes neuroticism is modeled as well, for example in the work done by Rist and Schmitt [34].

From the models explained in section 2.1, only ALMA has implemented a personality factor in their model. However, a personality factor can be implemented manually, as will be done in this research for GAMYGDALA.

Personality Factor	Refers to
Openness to Experience (O)	A tendency to be curious, artistic, insightful, flexible, intellectual and original
Conscientiousness (C)	A tendency to be organized, efficient, reliable, self-disciplined, achievement-oriented, rational and deliberate
Extraversion (E)	A tendency to be positive assertive, energetic, social, talkative and warm
Agreeableness (A)	A tendency to be forgiving, kind, generous, trusting, sympathetic, compliant, altruistic and trustworthy
Neuroticism (N)	A tendency to experience anxiety, tension, self-pity, hostility, impulsivity, self-consciousness, irrational thinking, depression and low self-esteem

Table 1: Factors of the Five Factor Model

Color	Refers to	How to Communicate	Stress Signals
Fiery Red	Competitive, demanding, determined, strong-willed, purposeful	Get to the point, links performance to success criteria	Becomes aggressive, impatient, irritable, demanding
Sunshine Yellow	Sociable, dynamic, demonstrative, enthusiastic, persuasive	Frame the issue within the wider picture and use stories to illustrate the under-performance. Acknowledge and praise areas where performance has been good. Watch out for blame being passed. Use humour	Becomes over responsive, appears opinionated, argumentative
Earth Green	Caring, encouraging, sharing, patient, relaxed	Take it slowly and allow time for a response. Frame the issue sensitively and avoid allocating blame. Stress the benefits to the team as a whole.	Becomes silent, withdrawn or hurt, judgemental, impersonal, resistant, stubborn and over cautious
Cool Blue	Cautious, precise, deliberate, questioning, formal	Present the facts in an orderly and tidy manner. Have the information written down for analysis later on. Allow for periods of silence and reflection.	Becomes questioning and deliberate, nit picking, aloof, withdrawn and resentful

Table 2: Insights Discovery Colors Model

### 2.3 Coping

According to Lazarus, coping consists of the cognitive and behavioral efforts to master, reduce or tolerate the internal and/or external demands that are created by a stressful transaction [35]. The Transactional Model of Stress and Coping describes two general types of coping: (i) alter the event causing the distress (problem-focused coping, PFC), or (ii) regulate negative emotional responses (emotion-focused coping, EFC) [5]. PFC tends to predominate when people feel that something constructive can be done, whereas emotion-focused coping tends to predominate when people feel that the stressor is something that must be endured [36]. Different coping strategies can be found for PFC in Table 3 and for EFC in Table 4.

Coping Strategy	Explanation
Planning	Thinking about how to cope with a stressor
Suppression of Competing Activities	Putting other projects aside, trying to avoid becoming distracted by other events
Restraint Coping	Waiting until an appropriate opportunity to act presents itself
Seeking Social Support for Instrumental Reasons	Seeking advice, assistance or information

Table 3: Problem Focused Coping Strategies

Coping Strategy	Explanation
Seeking Social Support for Emotional Reasons	Getting moral support, sympathy, or understanding
Positive Reinterpretation and Growth	Managing distress emotions rather than at dealing with the stressor per se.
Denial	Denying the reality of the event
Acceptance	Accept stressor as real
Turning to Religion	Religious means to deal with stress
Shift blame	Shift blame to someone else

Table 4: Emotional Focused Coping Strategies

**Coping in NPCs** Marsella and Gratch [37] developed a model on how coping behavior can be modeled in NPCs. In their model, coping is considered when an emotionally significant event is brought into focus by a cognitive operation. The selection of a coping strategy is a four-stage process: (1) identify a coping opportunity, (2) propose alternative coping strategies, (3) assess coping potential and (4) select a strategy to apply.

### 2.4 Dialog

A dialog is a conversation or other form of discourse between two or more individuals [38].

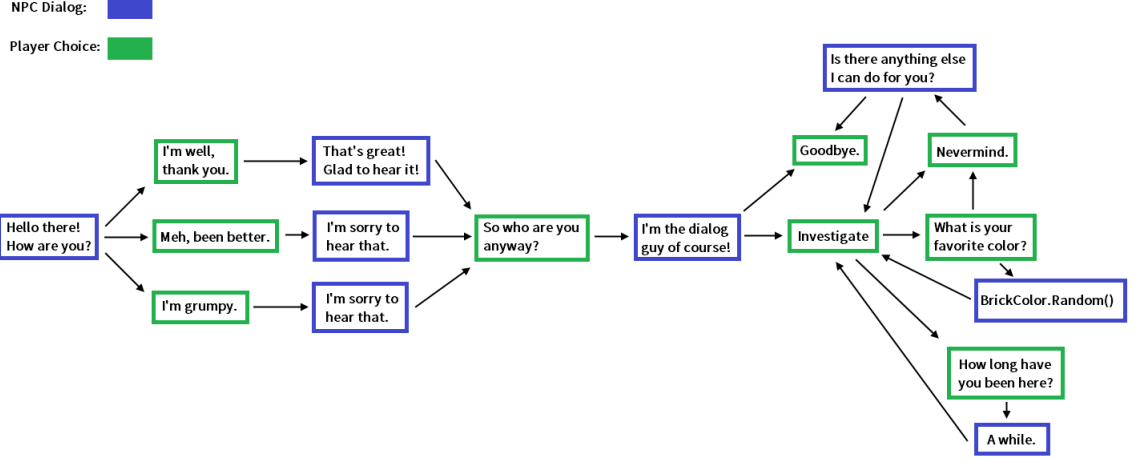


Figure 5: Example of a dialog tree

**Dialog in NPCs** Dialog is another important mechanism to make NPCs appear human-like. A method that is often used for dialog modeling with agents is a dialog tree. Each sentence that is said by an agent or player can be seen as a node. An edge  $\langle A, B \rangle$  is generated when the sentence in node  $B$  can be chosen if the last sentence said in the conversation was the sentence from node  $A$ . By modeling a complete dialog a dialog tree will be generated. An example can be found in figure 2.4. Conversation trees are very transparent, but can become very complex, labour-intensive and difficult to re-use [39].

In cognitive agents, reasoning from mental state of the NPC is a different approach to model the dialog. Cognitive agents are agents that can make decisions. The belief-desire-intention (BDI) framework is a framework that is often used to model cognitive agents [40]. The set of beliefs reflect the information the agent has about its environment. Desires correspond to the state of the environment the agent prefers. Intentions correspond to the state of the environment the agent is trying to achieve, which is a subset of the agents desires [40]. In a dialog the most events that occur are the sentences said by the player to the NPC. Based on the beliefs of the NPC a sentence will be selected that the NPC will say to the player.

## 2.5 Believability, Replayability and Immersion

**Believability** Believability has an important role in player experience. Character believability can be defined as "Someone believes that the character/bot itself is real, i.e. an actual living being" [41]. NPCs that are believable can bring major advantages for a game. Many games become more engaging if the player beliefs that the NPC is being controlled by another human [41]. A reason

why playing games with real human is more engaging is that humans are less predictable [41].

**Replayability** Replayability is a quantifiable measure to measure the enjoyability of a game. That is, a measure of how long a person can enjoy a game before it becomes boring [42]. Generating different gaming experiences is one way to favor the replayability of a game [28]. Different gaming experiences can be achieved by creating different personalities for the NPC.

A serious game for training in bad news with a higher replay value enables the player of the game to play the game more often. It is known from psychology that repetition increases knowledge and skill learning [43, 44]. Therefore, a game with a high replay value potentially increases the learning gain obtained by the player.

**Immersion** Immersion is used in game technology to describe the degree of involvement with a computer game. Factors that can favor immersion are: computer graphics, affective computing and advanced user interfaces [45]. A player with a higher level of immersion has many benefits when playing a game. Immersion favors the level of realism in a game [46] and allows the player to feel more present in the simulated environment. This helps in memorizing a procedure better [47].

## 2.6 Bad News

Bringing bad news is a task that each manager or doctor needs to do. It is a difficult task to perform that comes with multiple fears and pitfalls. Emotions and emotional coping play an important role in these pitfalls. Buckman [48] has listed different fears that people encounter when delivering bad news. Some of them are fear of being blamed, fear of unleashing a reaction and fear of expressing emotion. Pitfalls that people fall into include bargaining (allowing the conversation to become a negotiation when it really cannot be one), cushioning (softening the message so much that the other person does not even understand what you are talking about), unloading (delivering the message in a panicked and hurried way that frees you from the emotional burden, but then just dumps it onto the receiver), arguing (allowing yourself to be drawn into an argument or fight, when the decision has already been made and will not be changed) and mechanizing (delivering the message in a stilted, awkward, robotic style that has little empathy and is hardly dignifying) [49].

## 2.7 Bad News Training Games

A game in which a player practices to deliver bad news does currently not exist. Van Straalen et al. [50] have researched Embodied Conversational Agents (ECA) with social and emotional capabilities that are used for training in medical bad news conversations. They have not (yet) made this research into practice in terms of an application or serious game. Andrade et al. [51] have created an environment in which a trainee can be trained online. A virtual room is developed in which two avatars are acting. One is controlled by the trainee and the other is controlled by a standardized patient. Using this environment saves traveling time for the trainee and / or the standardized patient.

Domain name	Description	Examples of domain elements
Object	Elements of the external world (physical, social), represented by cues (agent's perceptual input)	Other agents, events, physical objects
Cognitive	Internal mental constructs necessary to generate emotions, or manifest their influences on cognition	Cues, situations, goals, beliefs, expectations, norms, preferences, attitudes, plans
Abstract	Theory-dependent; e.g. dimensions, appraisal variables, OCC evaluative criteria	Pleasure, arousal, dominance, certainty, goal relevance, goal congruence...
Affective	Affective states (emotions, moods) & personality traits	Joy, sadness, fear, anger, pride, envy, jealousy, extraversion
Physiology	Simulated physiological characteristics	Level of energy
Expressive Channels	Channels within which agent's emotions can be manifested: facial expressions, gestures, posture, gaze & head movement, movements, speech	Facial expressions (smile, frown), speech (sad, excited), gestures (smooth, clumsy), movement (fast, slow) (represented via channel-specific primitives, e.g. FACS)
Behavioral	Agent's behavioral repertoire in its physical and social environment	Walk, run, stand still, pick up object, shake hands with another agent

Table 5: Domains Required to Implement Affective Models in Agents. *The set of domains in the table represents a superset of possible domains required for emotion modeling. For a given model, and given theoretical foundations, only a subset of these may be necessary.*

### 3 Research Question

The main research question that will be addressed is:

**How can we model different artificial personalities through the expression of emotions and emotional reactions and what is the effect of different artificial personalities on the believability of a non-playing character, replayability of the game and immersion of the player in the context of bad news conversations?**

To answer this question, the following questions need to be answered:

- Which personality traits, emotional behavior and coping strategies are important in bad news conversations?
- How can emotion and personality be linked in an agent-based computational model that generates the verbal and non-verbal behavior of the non-playing character in a conversational setting?
- What is the effect of different artificial personalities on the believability of the non-playing character, replayability of the game and immersion of the player?

#### 3.1 Hypotheses

It is expected that creating different artificial personalities results in a higher believability of the NPC. According to Tence et al. [52] the following criteria determine the believability of the NPC: quality of speech, facial expressions, gestures and reactions to others. By creating different artificial personalities the reactions that the NPC gives should fit for that personality and should therefore be less random. As a result the believability of the NPC should increase.

It is also expected that by using different artificial personalities the replayability of the game increases. Different experiences that a player can obtain is one of the aspects that increases replayability [42]. By creating multiple personalities the experience gained by the player should increase, and thus the replayability of the game as well.

Finally it is expected that the immersion of the player does not necessary need to increase by adding different personalities. Brown and Cairns [53] listed three levels of involvement: engagement, engrossment and total immersion. This involvement moves along different barriers. To lower the barriers to enter engagement, the gamer needs to invest time, effort, and attention. The game itself has thus no influence on engagement. The barrier to engrossment is game construction. Adding different personalities might thus influence the engrossment (which can result in total immersion). However, engagement needs to be entered before engrossment can be entered. Game construction has thus only an influence if the player invests time, effort and attention.



## 4 Bad News Conversations Domain Knowledge

A conversation with an expert in the domain of bad news in corporations was held to get a better insight in bad news conversations. The knowledge that is obtained during this conversation is explained in this section.

### 4.1 Reasons for Bad News Conversations

There are frequent situations in a corporation that makes a bad news conversation necessary:

- Getting fired
- No contract extension
- A bonus that will not be given
- Being removed from a project
- The manager itself will be leaving
- A bad review of the current working performance without further consequences
- Not being allowed to do a training or study
- Changes that occur (e.g. a change in formation of the project team, a change in terms of employment, moving to another location)
- Having the intention to bring good news which will result in bad news (e.g. letting an employee present its project who does not want to do that).

### 4.2 Training in Bad News Conversations

The most common way to train in bad news conversations is by using an actor who is acting as the BNR. Reasons for training are (i) Giving a manager all the tools and skills necessary to be successful (and thus including the skills for breaking bad news) and (ii) someone who has difficulties in breaking bad news and asks for personal assistance. In a bad news training the goal can be to gain knowledge and skills, but also to get insight in why it is difficult to be direct in a conversation. Training breaking bad news consists of three parts: (i) gaining knowledge in how to tackle breaking bad news, (ii) practicing in breaking bad news and (iii) awareness in what can go wrong in a bad news conversation, for example falling into a pitfall.

### 4.3 Challenges in Delivering Bad News

The two main challenges in bad news conversations are (i) bringing the bad news and (ii) dealing with the reaction of the BNR. Bringing the bad news and dealing with the reaction of the BNR comes with many pitfalls. Different pitfalls are described in section 2.6. Other pitfalls mentioned by a bad news specialist are: hang yourself (trying to let the BNR discover the news himself by asking questions), not telling the message immediately, showing too much

emotion and applying a "do not shoot the messenger" tactic (saying that it is not your fault). Different strategies exist in how to deal with the reaction of the BNR, dependent on its reaction. These strategies are useful to tackle the second challenge. The strategies can be found in Table 6.

The structure of a good bad news conversation is as follows:

1. Tell the bad news
2. Verify whether the BNR has understood the message
3. Name the emotion of the BNR
4. Discuss future steps

#### 4.4 Goals in Delivering Bad News

The BND should have two main goals in a bad news conversation: (i) Maintain the relation between the BND and the BNR and (ii) make sure the message is delivered in a clear way. The first goal is important, because the BND most of the times still needs to work a few months at the company. It is thus important that the BND remains motivated for these last months. This can be gained by keeping a good relationship between the BND and the BNR. The second parameter is important to make the conversation easier for the BND. If the message is not delivered in a clear way, the BNR may not understand the content of the message directly. This might lead to stronger negative emotions from the BNR resulting in a more difficult conversation.

#### 4.5 Personality Modeling

This project will focus on a conversation between a BND and a BNR. It is thus only meaningful to model personality dimensions that determine how one behaves in a conversation, and that a mapping can be made between a personality and this behavior. A bad news conversation specialist suggested to make use of the Insights Discovery Colors (IDC) model [54]. This model defines four colors (classes), each belonging to a personality. The four colors are Fiery Red, Sunshine Yellow, Earth Green and Cool Blue. People with a preference for Fiery Red are extroverted and have high energy. They are action oriented and always in motion. They will approach others in a direct, authoritative manner, radiating a desire for power and control. People with a preference for Sunshine Yellow are strongly extroverted, radiant, and friendly. They are usually positive and concerned with good human relations. They will approach others in a persuasive, democratic manner, radiating a desire for sociability. People with a preference for Earth Green focus on values and depth in relationships. They want others to be able to rely on them. They prefer democratic relations that value the individual and are personal in style, radiating a desire for understanding. People with a preference for Cool Blue are introverted and have a desire to know and understand the world around them. They prefer written communication in order to maintain clarity and precision, radiating a desire for analysis.

The IDC model might make it easier to map a personality to behavior in bad news conversations, however there is no literature to be found about this model.

There is thus no theoretical background for this model, and no previous work of applying this model in NPCs. Different characteristics of the personalities of the IDC model are explained in [55]. An overview can be found in table 2.

Reaction of BNR	Strategy
Angry	Naming the emotion of the BNR, show understanding for emotion
Denial	Repeat the message
Nonchalant	Check if message is understood
Sadness	Name the emotion of the BNR, show understanding for emotion
Attack	Set limits, make sure conversation does not get out of the hand

Table 6: Strategies to deal with the reaction of the BNR after telling the bad news.

## 5 Personality, Emotion and Coping in Bad News Conversations

This section answers the first subquestion: "Which personality traits, emotional behavior and coping strategies are important in bad news conversations?" Personality, emotion and coping might play a different role in bad news agents compared to regular agents. To analyze the role of these factors some case studies are made. In these case studies different examples of bad news conversations are analyzed. Some of these conversations are performed well by the BND, where in others the BND falls in a pitfall. These cases can be found in Appendix A.

From these cases it is hard to detect the personality of the BNR in terms of the FFM model. This can suggest that it is not very useful to model personality in the NPC using FFM, since the player might not notice much difference between different personalities. It seems easier to link personalities from the Insights Discovery Colours Model to the BNRs outlined in the cases. For example, the BNR in case 1 is patient and calm, understanding, trying to find a solution and wanting to know why she got fired. This overlaps well with the "Sunshine Yellow" and "Earth Green" in the Insights Discovery Colors Model. The BNR in case 2 is getting angry and blaming the BND. She is direct, demanding and strong-willed. This corresponds with the "Fiery Red" Color. The same holds for the BNR in case 3. Case 4 is really short, and there is thus not much to say about the BNR in this case. In case 5 the BNR is starting a discussion, thinking along, being direct, denying and wanting to be in control. This fits well with the "Sunshine Yellow" color. The BNR in case 6 is showing emotion and focused on people. This suits well with the "Earth Green" color.

In bad news conversations the main emotions expressed by the BNR are: Confusion, Anger, Sadness and Surprise. These emotions fit well in the categorical emotional model proposed by Ekman [12], except for confusion. The OCC model does contain confusion, anger and sadness, but not surprise.

From the analysis in appendix A and the knowledge from the bad news

specialist the following coping strategies are most applied in bad news conversations: planning coping, acceptance coping, denial coping, blame coping and seeking social support coping.

## 6 Linking Emotion and Personality Into a Computational Model

This section answers the second subquestion: "How can emotion and personality be linked in an agent-based computational model that generates the verbal and non-verbal behavior of the non-playing character in a conversational setting?" From sections 2.1 and 2.2 we know that the OCC model of emotions is the state-of-the-art appraisal model and the FFM model is the state-of-the-art personality model. The five factors of FFM can be mapped into the Pleasure-Arousal-Dominance (PAD) domain, as can also be done for the OCC model of emotions. Besides the fact that the IDC model fits best for this domain, as explained in section 5, the IDC model of personality is not used initially. The main reason for this is that the IDC model cannot be linked to an emotional model. On top of that, the IDC model does not have any background literature. However, for future work, a mapping can be made from the IDC model to the FFM model. By mapping both the FFM model and the OCC model into the PAD domain, a mapping can be created between a personality and an emotion. This mapping can be seen as a personality-emotion relation. Calculating a relation between a personality and emotion is based on the work of Egges et al. [56]. In the work of Egges et al. a personality-emotion influence matrix was created. This matrix indicates how each personality factor influences each emotion.

The mapping from the FFM domain into the PAD domain is obtained from [57] and can be found in an introduction to ffm equation 1.

$$\begin{aligned} Pleasure &= (0.21E) + (0.59A) + (0.19N) \\ Arousal &= (0.15O) + (0.30A) - (0.57N) \\ Dominance &= (0.25O) + (0.17C) + (0.60E) - (0.32A) \end{aligned} \quad (1)$$

where  $E$  stands for extravertness,  $A$  for agreeableness,  $N$  for neuroticism,  $O$  for openness and  $C$  for consciousness.

The emotion categories from the OCC model can also be mapped into the PAD domain. This mapping is obtained from [21] and can be found in table 7.

By mapping both the personality factors from the FFM model and the emotions from the OCC model into the PAD space, it is possible to compare each emotion with each personality factor. The euclidean distance between an emotion and personality factor is calculated using equation 2.

$$PEfactor = \sqrt{(E_p - P_p)^2 + (E_a - P_a)^2 + (E_d - P_d)^2} \quad (2)$$

where  $E_p$  stands for emotion in the pleasure domain,  $P_p$  for personality in pleasure domain,  $E_a$  for emotion in arousal domain, etc.

This factor can influence the emotion of the NPC in multiple ways:

1. By using a threshold: Using the condition: PE factor  $> t$  for a threshold  $t$ , the emotional state of the agent will only be updated for an emotion if

<b>Emotion</b>	<b>P</b>	<b>A</b>	<b>D</b>
Admiration	0.5	0.3	-0.2
Anger	-0.51	0.59	0.25
Disliking	-0.4	0.2	0.1
Disappointment	-0.3	0.1	-0.4
Distress	-0.4	-0.2	-0.5
Fear	-0.64	0.6	-0.43
FearsConfirmed	-0.5	-0.3	-0.7
Gloating	0.3	-0.3	-0.1
Gratification	0.6	0.5	0.4
Gratitude	0.4	0.2	-0.3
HappyFor	0.4	0.2	0.2
Hate	-0.6	0.6	0.3
Hope	0.2	0.2	-0.1
Joy	0.4	0.2	0.1
Liking	0.4	0.16	-0.24
Love	0.3	0.1	0.2
Pity	-0.4	-0.2	-0.5
Pride	0.4	0.3	0.3
Relief	0.2	-0.3	0.4
Remorse	-0.3	0.1	-0.6
Reproach	0.3	-0.1	0.4
Resentment	-0.2	-0.3	-0.2
Satisfaction	0.3	-0.2	0.4
Shame	-0.3	0.1	-0.6

Table 7: Mapping of OCC emotions into PAD space

the relation between the personality of the agent and the emotion is high enough. The disadvantage of this approach is that if this threshold is not met, the agent can never feel this emotion. The believability of the agent might decrease if it cannot feel certain emotions.

2. By adapting the intensity of the emotion: the intensity of an appraised emotion will be multiplied with the PE factor and normalized between 0 and 2. As a result the agent will feel emotions that are well-related (PE factor  $> 1$ ) to its personality with a higher intensity than emotions that are less related (PE factor  $< 1$ ) to its personality.
3. By adapting the decay function of the emotion: The personality-emotion factor can be used to influence the decay of an emotion. As a result the agent will feel emotions that are well-related to its personality longer on a higher intensity than emotions that are less related to its personality.

For this research we want personality modeled in such that:

- The fluctuations of emotions between different personalities are big, to have a high replayability
- The fluctuations of emotions within a personality are small, to have a high reliable, and therefore believable agent

All three options have been implemented and analyzed. From this analysis we know that it is very difficult to determine the threshold  $t$  in option 1. Also, the believability of the agent decreases because it cannot feel certain emotions for a personality. For the purpose of this research we use option two: adapt the intensity of the emotion. This option fits best to the two important factors listed above. It allows for much variety in emotions between different personalities. For one personality the emotion intensities remain stable enough to appear believable. In practice, option 3 is quite similar to option 2 but option 2 allowed for more variation between different personalities.

## 7 Design of Prototype Game

In this section the design of the game is described. A case is created that will be the topic of the game. After that an architecture is created explaining all the details on the structure of the game.

### 7.1 Case

The player of the game will take the role of the manager of a company. The NPC is an employee that has been working for one-and-a-half years at the company. His contract expires in six months. After these six months the employee needs to get a permanent contract to be able to keep working at the company. Six months ago the employee had an evaluation conversation with the manager. The manager was very pleased with the work of the employee. Three months ago another conversation meeting took place. Before this conversation the employee had missed a deadline and not finished a project in time. The attitude of the employee decreased and in the current project another deadline was missed. On

top of that, it is questioned whether his job will still exist in a year. The company needs to restructure and as a result some jobs will disappear. The employee is however a nice person that is willing to help others. Yet the manager has decided not to renew the contract of the employee. The manager needs to tell this bad news to the employee now.

## 7.2 Architecture

This section describes which components are implemented, what the role is of each component and the relation between the components. The architecture can be found in figure 6. When an event occurs the beliefs, desires and intentions of the NPC will be updated. The personality together with the goals, beliefs, desires and intentions are the input of the appraisal engine. The appraisal engine updates the emotional state of the agent. The beliefs, desires, intentions and the emotional state together select an action that the NPC will perform. Next, the player will select an option that the NPC perceives as an event. The list from which the player can choose is generated based on the beliefs and desires of the player agent. In the following subsections the different components are further explained where this is needed.

This architecture was created in an iterative process with trial and error and many discussion sessions with &Ranj. The result is a working BDI (Beliefs, Desires, Intentions) dialog system in which the emotion, influenced by a personality factor, together with events are the only input that determines the action of the NPC. In the following sections the most important decisions in the design phase are explained in more detail.

### 7.2.1 Agent

Both the NPC and the player are modeled as an agent according to the BDI model. By using BDI over a dialog tree it is expected that the dialog will become more flexible and unpredictable because there is no 1 on 1 link between a sentence said by the player and a sentence said by the NPC. By using this approach it is easy to add new sentences to the conversation. The only thing that needs to be done is to generate a rule (based on the beliefs, desires, intentions and emotions of the NPC) that includes the conditions that need to be met before the NPC can say this sentence. A big disadvantage of this approach is that it is difficult to keep track of the dialog flow. Because of the large amount of possibilities in which a dialog can go, it might be difficult to debug the dialog and for example find scenarios in which the NPC says a sentence that does not fit in the conversation. It is thus a challenge to define the conditions that need to be met before a sentence can be said.

We wanted to model the agent as simple as possible as this would simplify the process in making content for narrative games in the future for a game designer. Therefore the agent only reasoned from its beliefs at the beginning of the design process. However, by only using beliefs it was impossible to keep the conversation structured. The NPC often had a lot of sentences to choose from, of which many were out of context. Therefore we chose to add desires in the agent model. By adding desires the set of sentences that the agent can choose from can be limited. This makes it a lot easier to prevent the agent to say sentences out of context. However, it happened regularly that multiple

desires were active at the same time. As a result, the agent still often changed topic. This was solved by adding intentions to the model. The intention of an agent is the desire that is currently trying to be achieved (explained later in this section).

The decision to model the player as an agent has been made later on in the process. At first, a list with possible events from which the player can choose was predefined for each action. The problem with this approach is that an action can be selected on multiple places in the conversation. The list with possible events was thus the same for each time this action was performed. This resulted in events that were out of context. Therefore the decision is made to model the player as an agent as well. The list with possible events is now generated based on the beliefs of the player agent so that out of context events can be avoided.

**Beliefs** The set of beliefs of an agent defines how the agent sees the environment. A belief has the following properties:

- **Name:** the name of the belief.
- **Likelihood:** a value between 0 and 1 that defines how likely the belief is (0 means the belief is disconfirmed, 1 means the belief is confirmed) from the perspective of the agent.
- **Affected goals:** an array of goals that are affected by this belief.
- **Congruences:** an array of values between -1 and 1 that define the congruences between the belief and the goals. The array has the same length as the array of affected goals. The congruence value at index  $i$  in the congruences array corresponds to goal at index  $i$  in the affected goals array. A negative value means that the belief is blocking the goal, where a positive value means that the belief is facilitating the goal.

If an event happens that influences a certain belief, the likelihood of that belief is updated accordingly.

**Desires** Desires can be described as the topics in the conversation that the agent wants to talk about. These topics can be very large (for example, the desire "convinceToKeepJob" can be active for a very long time), or very short (for example, the desire "explainEmotion" will be active during only one action).

A desire has the following properties:

- **Name:** the name of the desire.
- **Agent:** the name of the agent this desire corresponds to.
- **Active:** a boolean value that defines whether this desire is active or not. If the desire is active it can be selected as the current intention of the agent.
- **Reaction:** a boolean value that defines whether this desire is a reaction onto something said by the other agent. If this value is true the desire will stay active for only one tick. If this value is false, the desire will stay active until the conditions are met to make the desire unactive. This value simplifies the content creation process, as no extra rules have to be made that state when the desire needs to be unactivated.



- **Priority:** a boolean value that defines whether this desire has priority. If this value is true, the desire is immediately set as the intention of the agent when the desire becomes active. If this value is false this desire can be selected (if it is active) as the new intention when the agent does not have an intention. The value is a boolean and not an integer because the desire that has become active most recently (with a true priority) will become the new intention. There is thus no need to rank the desires based on priority. The priority parameter is mainly used to answer a question. When a question is asked, you want to answer that immediately. By giving the desire that answers that question a priority the NPC will immediately answer the question.

**Intentions** The intention of the agent is an active desire that is currently trying to be achieved. For this game the intention is thus the topic that the agent wants to talk about. This intention will stay the intention of the agent until one of the following happens: the desire is not active anymore, or a desire with a priority has become active. If the desire is not active anymore, a new active desire will be chosen randomly. If a desire with a priority becomes active, that desire will become the intention of the agent.

Intentions only apply to the NPC agent. In fact, the player chooses its own intention. Intentions do not apply to the player agent, because, in fact, the player chooses its own intention. If the player agent has multiple active desires, all possible events will be shown to the player from which the player can select one option.

**Goals** The goals of the agent are states that the agent wants to achieve. A goal has the following properties:

- **Name:** The name of the goal.
- **Agent:** The name of the agent that owns this goal.
- **Utility:** A value between -1 and 1 that defines the level of desire the agent wants this goal to be achieved. If the value is 1, the agent really wants the goal to be achieved. If the value is 0, the agent really does not want the goal to be achieved.

**Percepts** A percept can be seen as a keyword that describes the meaning of an event or action. Many different actions or events have the same influence on the beliefs of the other agent. Therefore, percepts are introduced to reduce the amount of rules that update the beliefs. The system does work without using percepts, but percepts are added to maintain the overview on updating the beliefs. The role of percepts will be explained in more detail later this chapter.

**Belief History** The belief history of an agent is a list that contains all the beliefs that the agent had in the past. This belief history can be used to check if a belief ever had a certain likelihood or to see how much the likelihood of a belief has changed from the last action or event. For example, if the likelihood of the belief 'fired' is now 0.8 but has been 1 in the past the agent should react different (e.g. hopeful) than when the belief 'fired' has never been 1, where the

agent almost knows he / she will be fired. The belief history is added later in the process to reduce the amount of beliefs needed. At first extra beliefs were added to check if a belief had a specific value in the past. For example the belief "heardNews" got a likelihood of 1 when the belief "fired" turned 1 and stayed 1 afterwards. This belief can now be removed because we can check in the belief "fired" if its likelihood has ever been 1.

**Avatar** An avatar from BotLibre is used in this game. This is the only free avatar found that is able to express emotions, able to talk and looks like a human. The only alternative was to create a new avatar by hand but this would take too much time and is not a goal of this research.

### 7.2.2 Appraisal Model

Many appraisal models exist, of which a few are described in section 2.1. The model that will be used needs to meet the following requirements:

- The engine should be easy to use for game designers. That means: it should be clear what variables that can be tuned and what they influence.
- It should be possible to add goals for the agent.
- The appraisal model should make use of a generic model of emotions.

From the appraisal models described in section 2.1, GAMYGDALA fits best with these requirements and will thus be used as appraisal model. GAMYGDALA is easy to use (you only need to create some goals and determine which beliefs have influence on which goals), makes use of the OCC model of emotions and includes BDI-based goal oriented reasoning and planning. On top of that, GAMYGDALA is developed at Delft University of Technology such that, if needed, the model can be adapted.

### 7.2.3 Personality

A personality will be modeled for the NPC. This is to let the player train with different characters to get a better preparation for a real bad news conversation. The FFM model will be used as personality model. It is the state-of-the-art model and it can easily be used to link with the OCC model of emotions that GAMYGDALA uses, as described in section 6.

The goal of this research is to get to know what the impact is of personality if it only affects the emotion of the agent. In this project, the personality is not used for anything else.

### 7.2.4 Emotional State

For each event that occurs GAMYGDALA can update one or multiple emotions and its corresponding intensit(y)(ies). The emotional state is a list with all 12 emotions from the OCC model and their current intensity. The emotional state is used as condition by the NPC to select an action. When an event occurs, the NPC can perceive one or multiple percepts. These percepts will update the beliefs of the NPC. The beliefs are appraised and the emotional state will be

updated. The intensities can only increase at this part. At the end of each tick all emotion intensities will decay.

The emotional state of the agent can have a role on the following levels:

- **Emotion within an action:** The emotion of the agent only decides how an action will be said. For example take the action in which the agent gives a first reaction to the bad news: an agent with a high angry emotion will for example say: "What?! This is such a bullshit!", while an agent with a high disappointment emotion will for example say: "Oh, thats a pity". The semantic of both actions is similar, but the emotion in the action differs.
- **Action selection:** The emotion of the agent decides which action the agent will choose. For example take the action in which the agent gives an argument to stay: an agent with a high angry emotion will for example say: "You cannot do this! Do you want to me to be evicted from my house?", while an agent with a high disappointment emotion will for example say: "But I am pregnant! I will never find a new job!". The semantic of these actions is different. The agent with an angry emotion starts to blame the bringer of the bad news, and talks into his conscience. The agent with a disappointment emotion is worried about its future.
- **Desire selection:** The emotion of the agent decides what desires will be adopted or dropped.

Early in the design process the emotional state only played a role in the first level: emotion within an action. Later on we added the emotional state in the action selection as well to improve the replayability. The emotional state does not yet have a role in the third level, desire selection. This can be added in future work.

### 7.2.5 Rules

There are different type of rules in the game that decide what events the player can choose from, what action the NPC will select, when a desire will be adopted or dropped and when a belief will be updated:

**ActionSelectionRules** An action can only be chosen if its preconditions are met. These preconditions are defined in the ActionSelectionRules. The preconditions are defined by the emotional state of the NPC, the beliefs and beliefhistory of the NPC and the intention of the NPC. To ensure the overview of these rules can be kept, the rules are categorized by intention. Thus, for each intention all actions are selected that are able to be chosen when this intention is active. Next, the beliefs and emotion intensities that need to be met for each action are defined. The actions possible within the current intention are filtered by these beliefs and emotion intensities. This results in a list with one or multiple actions is created that can be performed. From this list an action will be selected randomly that the agent will perform.

**UpdateBeliefsAndDesiresRules** The UpdateBeliefAndDesiresRules define what beliefs and desires will be updated when an agent perceives a percept.

First, each event updates or sets the likelihood of one or multiple beliefs. Desires are adopted or dropped based on the beliefs and beliefhistory of the agent.

**EventOptionsRules** The eventOptionsRules are similar to the ActionSelectionRules but define which events the player agent can perform. The only difference is that there are no emotions in the preconditions because emotions are not modeled for the player agent. The preconditions are thus only based on the desires and beliefs and beliefhistory of the player agent.

### 7.2.6 Dialog

The dialog is modeled such that it only consists of actions and events. The NPC can choose an action to say, and the player can choose an event to say.

**Actions** The list of actions is a list of sentences that can be said by the NPC. An action has the following properties:

- **Name:** the name of the action.
- **Text:** the content of the action, thus the sentence that the NPC can say.
- **Repeat: (optional)** The content of the action, thus the sentence that the player can say if the action is performed for the second (or more) time. This favors the variation in the game.
- **Percepts: (optional)** a list containing the percepts that the agent player will perceive. When an agent perceives a percept, the beliefs that correspond with this percept will be updated.

**Events** The list of events is a list of sentences that can be said by the player. An event has the following properties:

- **Name:** the name of the event.
- **Text:** the content of the event, thus the sentence that the player can say.
- **Repeat: (optional)** The content of the event, thus the sentence that the player can say if the event is performed for the second (or more) time.
- **Percepts: (optional)** a list containing the percepts that the player agent will perceive. When an agent perceives a percept, the beliefs that correspond with this percept will be updated.

**Action History** The action history is a list that contains all the actions performed by the NPC. This list is used to increase the variability of the game. If an action that is performed already will be performed again, the content of the sentence will be the sentence defined in the "repeat" parameter.

**Event History** The event history is similar to the action history, but is a list of events instead of actions.

### 7.2.7 Content

The content of the game is made based on the pitfalls and fears as described in section 2.6, the challenges in bad news delivery from section 4.3, the goals in bad news delivery as described in section 4.4, the relevant coping strategies described in section 5, and the case from section 7.1. Some pitfalls that are described in sections 2.6 and 4.3 are implemented in the dialog:

**Pitfalls and Fears** Pitfalls that are implemented in the game include:

- **Bargaining:** The BND has the option to say that he is going to have another talk with the team, giving the BNR the feeling that he / she can stay.
- **Unloading:** The BND has the option to immediately end the conversation after the bad news is told.
- **Arguing:** The BNR can give different arguments to the bad news (for example being pregnant) on which the BND can react.
- **Hang yourself:** The BND has the option to ask the BNR how he / she thinks is performing.
- **Not telling the message immediately:** The BND has the option to talk about other things at first.
- **Do not shoot the messenger:** The BND has the option to say that this is not his choice, but the choice of the team.

A fear that the BND gets confronted with is:

- **Fear of being blamed:** The BNR can blame the BND as the cause of the bad news.

Not all pitfalls and fears listed in sections 2.6 and 4.3 are implemented. This is because the goal of this research is not to create a perfect game, but to research the role of personality through emotion on the replayability of the game, believability of the NPC and immersion of the player.

**Goals** The goals that the BND has in the conversation, as described in section 4.4, are related to the goals that the BNR has in the game and are appraised in GAMYGDALA. The performance of the BND can thus be seen back in the emotion of the player. If the BND is (close to) achieving a goal, the BNR will have positive emotions. If the BND is (close to) failing a goal, the BNR will have negative emotions.

**Coping strategies and the Reaction of the BNR** The coping strategies that are relevant for bad news conversations are related with the possible reactions the BNR can give to the bad news (Table 6). The BNR is able to apply all coping strategies and possible reactions. Of course, for each coping strategy or reaction some preconditions need to be met, as described in section 7.2.5.

## 8 Experimental Setup

According to Livingstone [58] the choice of evaluators is very important. For people who do not game often, the whole experience of playing a game is so new that they may fail to notice the significant differences between two versions of AI. By using people who are more experienced in gaming it is possible to identify the possible strengths and weaknesses of the NPC. In the end, the target audience of the game that will be developed are people that will be trained in delivering bad news. It is expected that most of these people are not experienced gamers. It is thus also needed to test the game on potential users to gain their opinion on the game.

In the experiment the goal is to answer the third subquestion from section 3: What is the effect of different artificial personalities on the believability of the non-playing character, replayability of the game and immersion of the player? Two different game modes are created: one in which the characters do not have a personality and one in which the characters do have a personality. By doing so it is possible to test what the influence is of the personality on the experience of the player. Three different characters are created for the game mode in which the characters do have a personality:

- Meyke; an angry person that easily blames the deliverer, stays long angry and gives arguments without content.
- Michelle; a soft person that easily accepts the news, does not get angry very quickly and understands the situation.
- Emma; a person that is scared about the future, wants to know why she is needs to go and gives meaningful arguments to stay.

Believability is subjective and is thus difficult to measure. According to Livingstone [58] determining or measuring believability is largely restricted to questionnaires. A questionnaire will therefore be used to analyze the believability of the NPC. The questions in this experiment are gathered from the work of Bevacqua et al. [59] and the work of Gomes et al. [60] who both presented an evaluation of believability of narrative characters in terms of a questionnaire.

According to Krall and Menzies [42] replayability is a qualitative measure to the enjoyability of a game. That is, measure how long a person can enjoy a game before it becomes boring. Replayability can thus be evaluated by asking the player to play the game until it becomes boring. By measuring the time the player plays the game the replayability can be measured. However, in an experiment people might have other reasons to stop playing. A participant of an experiment does not play the game to actually improve in delivering bad news and might therefore stop earlier playing the game than someone who does want to improve in delivering bad news. Therefore the amount of rounds will be preset and a questionnaire will be used to measure the replayability of the game. In the current literature there is no questionnaire available that measures the replayability of a game. The questions about replayability are therefore selfmade.

Jennett et al. [61] have researched how immersion can be measured. They found that an extended immersion questionnaire can best be used to measure immersion. The questionnaire developed in the research done by Jennett et al. is partially used in this experiment.

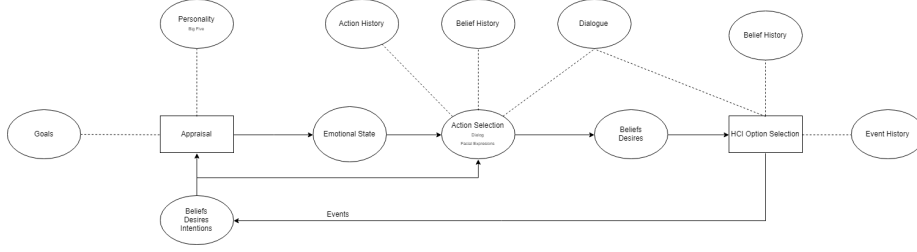


Figure 6: Architecture

The experiment is setup as follows: At first the player gets a short story in which the case is explained. The game mode that is played is selected at random. The player plays the game with each character twice. For the mode in which the characters do not have a personality the different characters behave similar. In both game modes the characters reason from the same knowledge and set of rules. The only difference between the two versions is that there is no personality factor added upon the emotion model in the version in which the characters do not have a personality. Every character will therefore have the same emotional intensities if the dialog is the same. After these six rounds the player gets a questionnaire that will measure the replayability of the game, believability of the character and immersion of the player.

## 9 Results

40 people participated in the experiment. From the questions of the questionnaire three constructs were created: replayability, believability and immersion. Reliability tests were performed on these constructs to detect unreliable questions. After removing unreliable questions the cronbach's alpha values for the replayability, believability and immersion cases are respectively 0.805, 0.789 and 0.718. An extra construct was created containing questions about the personality and emotions of the agent. This case has a cronbach's alpha value of 0.762. The questions belonging to these constructs (after removing unreliable questions) can be found in appendix B.

A multivariate general linear model is made from the questions in the replayability, believability and immersion constructs.

Measure	p-value
Replayability	.09
Believability	.09
Immersion	.85
Personality - Emotion	.55

Table 8: p-values

The results in figure 7 show that there is a positive trend on the replayability of the game and believability of the character when artificial personalities are modeled through the expression of emotions and emotional reactions. The immersion of the player is not improved. From table 8 we see that the results

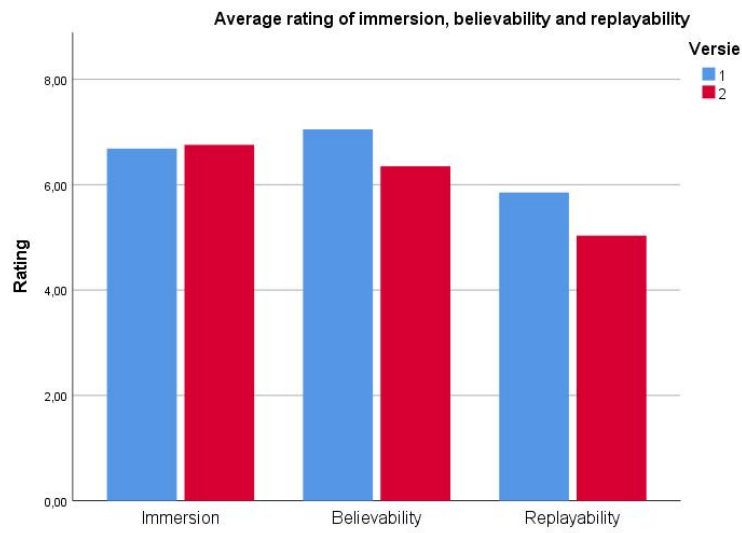


Figure 7: Results of immersion, believability and replayability constructs

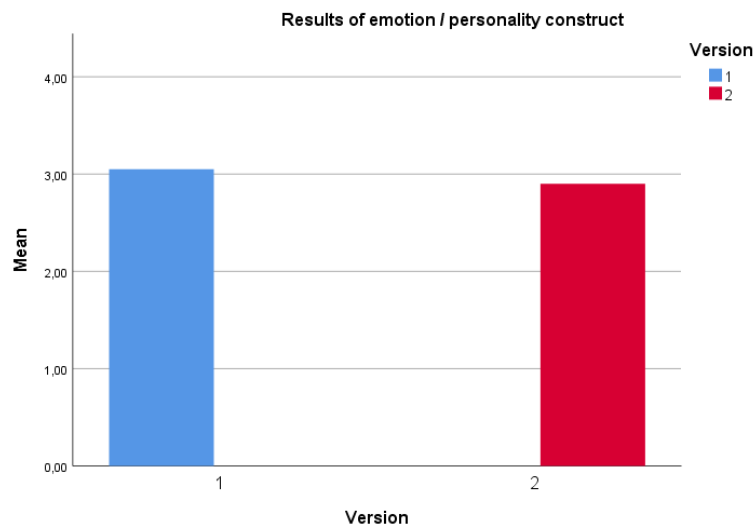


Figure 8: Results personality-emotion construct



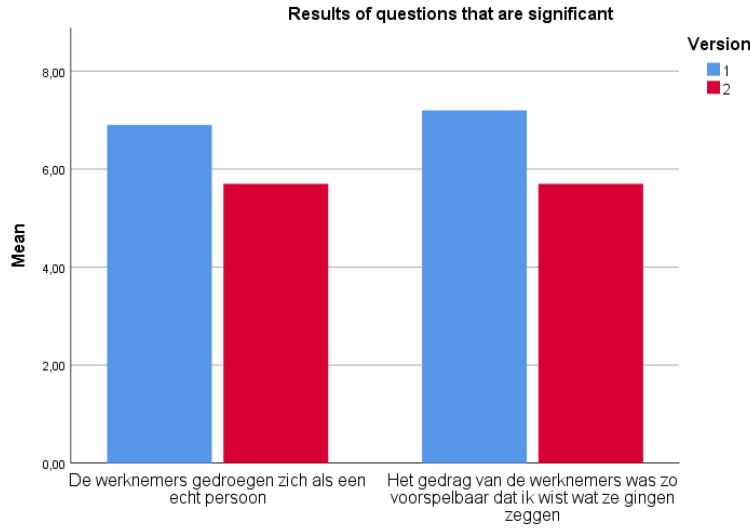


Figure 9: Results of significant questions”

are not significant for an alpha value of 0.05.

Two stand-alone questions that show significant results for an alpha value of 0.05 are:

- De werknemers gedroegen zich als een echt persoon ( $p = 0.044$ ).
- Het gedrag van de werknemers was zo voorspelbaar dat ik wist wat ze gingen zeggen ( $p = 0.022$ ).

The results of these questions can be found in figure 9.

## 10 Conclusion

The personalities described in the IDC model fit well with how people behave in bad news conversations. The most common emotions in bad news conversations are: confusion, anger, sadness and surprise. The following coping strategies are applied most often when someone hears bad news: acceptance coping, denial coping, blame coping and seeking social support coping.

Emotion and personality can be linked in a computational model by mapping the FFM model and OCC model into the PAD domain. By doing so, a distance between a personality and an emotion can be calculated. This distance can be used as a factor that influences the intensity of an emotion.

It can be concluded that there is a positive trend on the replayability of the game and the believability of the character when artificial personalities are modeled through the expression of emotions and emotional reactions. The approach that is used to develop this game has potential in terms of replayability and believability.

## 10.1 Discussion and Future Work

The results of the experiment agree with the hypotheses. There is a positive trend in believability and replayability but the immersion of the player does not increase.

Replayability is rated rather low in this experiment. The characters with different personalities respond differently, but the main storyline is similar. Each character has the same reason why she is being fired. This is done on purpose, because we want to know how the personality modeled through emotions has an impact on the replayability. The reason of being fired is not part of this. As expected, there is a positive trend in the replayability of the game when artificial personalities are added. By adding different artificial personalities the player of the game gains more experience resulting in a higher replayability value.

The overall replayability can thus be increased by adding different storylines for different characters. The personality of the character has influence on the tone on how a sentence is said and the content of a sentence (for example the action `giveArgument` is "I am expecting a baby" for a disappointed emotion and "This is your fault!" for an angry emotion), but not on which desires the agent has. The replayability can be increased by letting the emotion be a condition on the desires of the agent as well. For example, the desire "giveArgument" can not become active when the main emotion of the agent is 'happy'.

Believability is rated quite high already. As expected, there is a positive trend in the believability of the character by adding different artificial personalities. By adding different personalities the reactions that the NPC gives are less random. The main points on which believability can be improved are not content related. Improving the avatar and the voice of the agent are two main points that are returned as feedback from the participants of the experiment. The avatar was the same for the different personalities. This should not influence the difference between the two experimental groups in terms of believability, but it can improve the believability in general. The voice of the avatar was produced using the Google voice. This voice is not optimal yet, and some words are not pronounced properly.

As expected, the immersion of the player is not improved by adding different artificial personalities. The first level of immersion, engagement, needs to be achieved in order to influence engrossment. Barriers for engagement are access and investment. The people that joined the experiment did not play the game with the intention to improve the skills needed to deliver bad news. When people really want to improve in delivering bad news, the barrier of access might be removed. The barrier of investment might be removed by creating a more intense relation between the bad news receiver and bad news deliverer.

Despite the fact that there is a positive trend in replayability and believability, the results are not significant. A reason for this can be the small amount of participants that joined the experiment.

The approach used in this research comes with some challenges in content creation. There should be a clear approach on how to develop a game using the BDI approach so that game designers are able to work with it. At &Ranj the content is currently created before the game is developed. On the contrary, content creation is an iterative process when the approach that is proposed in this research will be used. The creation of the content (actions) goes step by step together with the creation of the game structure (beliefs, desires, intentions,

emotions and rules). A first version of the roadmap to create content using this approach can be found in appendix C. This roadmap is based on the process that is mainly used in creating the prototype game. The content creators at &Ranj indicate that a lot of practice is needed to get a better insight in how to apply this approach. In this, practice is mainly needed to (1) get insight in what the effect is when parameters (e.g. beliefs, goals, emotions) are changed and (2) what parameters need to be changed in order to get a specific result in the game.

The personality is currently defined using the FFM model. From the perspective of a game designer this is rather vague. By defining a relationship between the insight colors model and the FFM model, it is easier for game designers to define how such a personality should behave in the game.

Turntaking and natural language processing are two mechanics that can increase the immersion of the player, and the replayability of the game. Sometimes it is good to let the bad news receiver take some time to process the news. As BND it is thus good to wait some time to say something back. By choosing the time when to say something the agent will react different, possibly resulting in a higher replayability. On top of that, if you can type in what you want to say instead of choosing from a predefined list of options, it is easier to fall into a pitfall. By adding turntaking and natural language processing you might feel more present in the game, which results in an improved immersion.

Non-verbal communication by the player is currently not recognized by the agent, but has an important role in bad news conversations [3]. By adding a system that recognizes the non-verbal communication of the player and let the agent react on the non-verbal behavior of the player, the player can also learn on how to behave non-verbally in a bad news conversation.

## A Case Studies of Bad News Conversations

Dialog	Analysis
<b>BND:</b> Hoi Wendy, fijn dat je er bent. Ga zitten. Ik heb eigenlijk slecht nieuws voor je. We hebben als organisatie besloten om jou als vrijwilliger uit je functie te zetten.	
<b>BND:</b> Ik zie dat je stil bent. Wat gaat er in je om?	Name what you see strategy
<b>BNR:</b> Waarom eigenlijk? Ik ben een beetje in de war. Ik weet niet hoe ik het moet plaatsen.	Confused emotion
<b>BND:</b> Als in je begrijpt niet helemaal wat er aan de hand is?	
<b>BNR:</b> Nee	
<b>BND:</b> Wat is je eerste ingeving? Want ik vertel dat je geen vrijwilliger meer bent, maar hoe voel je je erover?	Repetition strategy
<b>BNR:</b> Eigenlijk best wel een beetje boos.	Angry emotion
<b>BND:</b> Waarover dan precies?	
<b>BNR:</b> Het komt er nog niet helemaal uit. Ik ben er een beetje stil van. Het komt nog niet helemaal binnen.	Sad emotion
<b>BND:</b> Het is ook best wel heftig natuurlijk nu ik dat zo zeg.	
<b>BNR:</b> Ja, maar wat is dan eigenlijk de reden?	
<b>BND:</b> Dat wil ik graag toelichten. We hebben vaker een gesprek gehad over je functioneren en we zijn van mening dat het niet gaat werken. Je komt vaak te laat en zit vaak met anderen te praten waardoor je vaak je bardiensten in het verschiet laat. We hebben dat vaker aan gegeven en dat loopt niet lekker. Wij als organisatie hebben er zoveel moeite in moeten steken dat het voor ons niet meer werkt na al die gesprekken die we hebben gevoerd. Begrijp je dat wel een beetje?	

<b>BNR:</b> Ja ik kan het wel een beetje plaatsen ja. Maar jullie weten dat ik ook studeer. Ik probeer zoveel mogelijk tijd door te brengen met de jongeren zodat ik een band kan opbouwen met de jongeren. Maar ik snap het eigenlijk niet, want ik heb al een aantal keer aangegeven dat ik een aantal bardiensten niet kan draaien.	
<b>BND:</b> Dat klopt. Dat is naar voren gekomen in gesprekken en daar hebben we rekening mee gehouden. Maar na een aantal akefietjes en waarschuwingen hebben we toch dit moeten besluiten.	
<b>BNR:</b> En dan mag ik me nergens meer mee bemoeien?	Disappointment emotion
<b>BND:</b> Je bent natuurlijk nog altijd welkom als bezoeker. Het is niet zo dat we je niet meer willen zien, maar als vrijwilliger bied je geen toegevoegde waarde meer voor ons.	
<b>BNR:</b> Maar is er nog wel een mogelijkheid om iets anders te doen? Want ik weet dat ik te laat kom, en ik weet dat ik dat niet kan aanpassen met school. Ik kan dat dus niet aanpassen. Maar ik vind het niet leuk als ik helemaal weg moet. Ik wil wel in contact blijven.	Seeking social support coping, Planning coping
<b>BND:</b> Ja daarom zeg ik dat je als bezoeker welkom bent. Wij hebben de beslissing gemaakt om jou als vrijwilliger te ontszeggen. Die beslissing gaan we niet terugdraaien.	
<b>BNR:</b> En ook niet als extra hulp bij bijvoorbeeld grote feesten?	
<b>BND:</b> Daar hebben we het ook wel over gehad. Het punt is dat het bij die grote feesten juist vaak fout gaat. Het is wel is voorgekomen dat je wat gedronken had. Daar heb ik toen ook wat van gezegd. Dat is ook niet meer gebeurt, maar het te laat komen wel. Het liever willen feesten dan iets doen voor de organisatie is elke keer mis gegaan. Dat begrijp je ook wel?	
<b>BNR:</b> Ja	

<b>BND:</b> Is het misschien een idee dat we nog een keer aan tafel gaan zitten en in gesprek gaan zodat je het nu een beetje een plek kan geven?	
<b>BNR:</b> Ja, ik weet nu niet zo goed wat ik moet zeggen en wat ik er van vind. Misschien heb ik wat meer vragen. Is er misschien wel een mogelijkheid dat ik op lange termijn kan bewijzen dat ik het wel kan?	Planning coping
<b>BND:</b> Dat hebben we in andere gesprekken een kans gegeven. We hebben dit nu echt besloten.	
<b>BNR:</b> Ik bedoel over een jaar, weer opnieuw.	Planning coping
<b>BND:</b> Dat zouden we als organisatie eventueel kunnen bespreken. Daar wil ik nog wel in terugkomen in het volgende gesprek.	
<b>BNR:</b> Dat is dan aan mij om het te laten zien.	Planning coping
<b>BND:</b> Ja, maar dat moeten we eerst overleggen. Daar kunnen we dan in het volgende gesprek over doorgaan.	
<b>BNR:</b> Dan kan ik er beter op reageren misschien.	
<b>BND:</b> Ja dan plannen we een nieuwe afspraak. Het is wel vervelend zo, maar ik hoop dat het langzaam doordringt en niet teveel gedoe voor je heeft. We hebben altijd veel plezier met jou als persoon gehad, dat is het niet. Op werkvlak lukt het gewoon niet zo dus we hebben besloten het zo te moeten doen.	
<b>BNR:</b> Ja dat moet nog wel doordringen. Ik zie nog niet helemaal voor me hoe ik daar mee om moet gaan.	
<b>BND:</b> Ja dan maken we een nieuwe afspraak. Dankjewel en we zien elkaar snel.	

Table 9: Case 1: Good Bad News Conversation 1

Dialog	Analysis
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<b>BND:</b> Cindy, welkom. Je hebt vorige week een sollicitatiegesprek gehad voor de functie van hypotheekadviseur en ik zou nu graag het resultaat willen bespreken.	
<b>BNR:</b> Ja, ik ben erg benieuwd	
<b>BND:</b> Ik heb niet zo'n leuke mededeling voor je, de commissie en ik hebben besloten om je af te wijzen voor deze functie.	
<b>BNR:</b> O, dat had ik niet verwacht. Dat verbaast me echt.	Surprise emotion
<b>BND:</b> Dat kan ik me voorstellen.	
<b>BNR:</b> Ik bedoel het gesprek ging goed, en moet je luisteren Robert, je stimuleert me zelf om verder te kijken. Dat heb je in het functioneringsgesprek nog gezegd. Ik snap op z'n minst niet dat ik niet voor een tweede gesprek wordt uitgenodigd.	Angry emotion, disappointment emotion, shift blame coping
<b>BND:</b> Ik zie je teleurstelling en zie ook dat je een beetje boos wordt.	Naming emotion strategy
<b>BNR:</b> Ja, ik voel me echt op het verkeerde been gezet.	
<b>BND:</b> En je voelt je met name op het verkeerde been gezet omdat ik je gestimuleerd heb om te solliciteren en je daarna heb afgewezen?	
<b>BNR:</b> Ja, jij bent mijn leidinggevende en kent mij heel goed. En ik vind ook dat ik kwaliteiten heb. Ik vind het echt heel raar dat ik op z'n minst niet voor een tweede gesprek wordt uitgenodigd. Ik vind dat hier politieke spelletjes gespeeld worden.	
<b>BND:</b> Het zijn hier geen politieke spelletjes. De reden dat je afgewezen word is omdat je niet voldoet aan de functie eisen van hypotheekadviseur. Je hebt het diploma niet, en je hebt de werker- varing niet.	
<b>BNR:</b> Moet je nou is goed luisteren. Hoe kun je nou ervaring hebben als je binnen een bedrijf intern solliciteert? Dan komt toch niemand verder?	

<b>BND:</b> Ik moet bekennen dat ik gezien mijn enthousiasme om jou te stimuleren aan iets voorbij ben gegaan: dat er binnen het team een zwaardere iemand moet zitten met werkervaring en een diploma. Achteraf is het niet goed geweest om jou uit te nodigen voor het sollicitatiegesprek.	
<b>BNR:</b> Als het om mijn diploma gaat; ik heb mijn CV moeten opsturen. Daar kan je op zien dat ik geen diploma heb. Waarom nodig je me dan wel uit voor een gesprek? Ik voel me echt op het verkeerde been gezet.	
<b>BND:</b> Dat ben ik helemaal met je eens, dat hebben we niet netjes gedaan.	
<b>BNR:</b> Nee, helemaal niet! Ik vraag me wel af, als dit het niet wordt, wat dan? Het directe klantencontact loopt terug. Ik wil wel wat anders binnen deze organisatie. Ik moet ook wel. Ik wil niet wachten tot er allemaal ontslagen vallen. Dit leek me wel een aardige functie.	Planning coping, seeking social support coping
<b>BND:</b> De deur is op dit moment inderdaad dicht. Ik denk wel dat je meer kwaliteiten hebt. De contactuele functies gaan op den duur inderdaad verdwijnen. Maar ik blijf erbij dat je geschikt zou kunnen zijn voor de functie van hypotheekadviseur.	
<b>BNR:</b> Ik vind het echt heel vervelend om terug te keren naar mijn team. Iedereen weet dat ik gesolliciteerd heb. Moet ik nu aan iedereen gaan vertellen dat ik het niet geworden ben? Moet ik blijven zitten waar ik zit? Ik dacht het niet.	Seeking social support coping
<b>BND:</b> Op dit moment hebben we geen andere functie. Maar ik denk niet dat je collegas raar op zullen kijken. Het is een interne sollicitatie maar dat betekent niet dat je niet afgewezen kunt worden.	
<b>BNR:</b> Ja, dat kun jij wel makkelijk zeggen.	
<b>BND:</b> Dat begrijp ik ook wel goed.	
<b>BNR:</b> Er wordt hartstikke gekletst, dat is toch zo.	



<b>BND:</b> Als je het vertelt mag je zeggen dat ik het verkeerd gedaan heb.	
<b>BNR:</b> En verder?	Resignation emotion, Acceptance coping
<b>BND:</b> Dat hangt ervan af wat je zelf wilt. Ik begrijp dat je wel de ervaring wilt opdoen. Zou je een opleiding willen doen?	
<b>BNR:</b> Ja, hangt er wel van af. Hoe lang duurt het? Hoe zwaar is het? Ik heb 2 kleine kinderen en ben kostwinner dus hoe ziet de toekomst er uit? Als ik die opleiding volg en dan weer afgewezen wordt..	Planning coping
<b>BND:</b> Ik begrijp dat je garantie wilt dat je in aanmerking komt.	
<b>BNR:</b> Garantie is een groot woord, maar ik wil dan niet meer te horen krijgen dat ik geen ervaring heb.	Planning coping
<b>BND:</b> Wat je zegt is dat je wel een opleiding wilt doen en een garantie dat als je solliciteert niet wordt afgewezen op een gebrek aan ervaring.	
<b>BNR:</b> Ja ik wil serieus genomen worden. Eventueel wil ik ook met iemand meelopen om ervaring op te doen.	
<b>BND:</b> Wat ik jou hoor zeggen is dat je een opleiding wil volgen en een soort stage wil doen. We hebben een opleidingsbudget. Wat heb jij nodig om een opleiding te volgen?	
<b>BNR:</b> Opleiding van een jaar, 1 dag in de week. Die moet dan wel betaald worden en ik moet tijd vinden om te studeren. Als ik daar 4 uur voor krijg en de rest in eigen tijd zou dat schelen.	Planning coping
<b>BND:</b> Daar zijn mogelijkheden voor. Je hoeft nu niet aan te geven hoeveel tijd je daaraan kwijt wilt zijn. In Groningen zijn verschillende opties. Het lijkt me goed als jij die gaat onderzoeken.	
<b>BNR:</b> Dan wil ik wel weten hoe jullie mij kunnen faciliteren	Planning coping
<b>BND:</b> Wij faciliteren in tijd en geld, afhankelijk van de duur en kosten van de opleiding. Het lijkt me een goed idee dat jij gaat kijken wat er mogelijk is.	

<b>BNR:</b> Oke, zullen we dan om de vaart er in te houden binnenkort weer een afspraak maken?	Planning coping
<b>BND:</b> Lijkt me een goed idee	

Table 10: Case 2: Good Bad News Conversation

Dialog	Analysis
<b>BND:</b> Jantien, ik heb slecht nieuws voor je. Wij moeten jou gaan ontslaan.	
<b>BNR:</b> Ontslaan?! Nee kom op, dat meen je niet.	surprised emotion
<b>BND:</b> Dat meen ik wel.	
<b>BNR:</b> Maar dat kan niet! Jij hebt mij 3 jaar geleden beloofd dat ik deze baan zou krijgen, dat ik promotie zou kunnen maken. Dat klopt toch niet?	Angry emotion, denial coping, shift blame coping
<b>BND:</b> Maar de situatie is natuurlijk wel veranderd.	Arguing pitfall
<b>BNR:</b> Ja tuurlijk is de situatie veranderd, maar jij hebt mij dat wel toegezegd!	Angry emotion
<b>BND:</b> Dat gevoel heb jij natuurlijk en dat snap ik ook wel	
<b>BNR:</b> Nee, dat gevoel heb ik niet. Dat is gewoon zo! Dat hebben wij afgesproken!	
<b>BND:</b> Nee dat is niet zo. Dat idee heb jij. Natuurlijk hebben we gekeken naar wat de groeimogelijkheden zijn, maar ik heb geen beloftes gedaan.	
<b>BNR:</b> Jij hebt mij beloofd dat ik door zou kunnen groeien, promotie zou kunnen maken en zelfs een andere functie zou krijgen!	
<b>BND:</b> Maar de situatie is veranderd. Dus..	

Table 11: Case 3: Bad News Conversation with Arguing Pitfall

Dialog	Analysis
<b>BND:</b> Jantien ik heb slecht nieuws voor je. We moeten jou gaan ontslaan.	
<b>BNR:</b> Wat?! Ontslaan?	Angry emotion

<b>BND:</b> Ja dit verrast je misschien, maar het is niet het eind van de wereld he. Het is een hele verandering, maar misschien is het ook wel een nieuwe kans voor je. Dit is rot nieuws, dat snap ik. Maar ja, je kunt met PNO gaan praten, die kunnen je gaan ondersteunen bij het zoeken van nieuw werk. Euh .. Jantien?	Cushioning pitfall
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Table 12: Case 4: Bad News Conversation with Cushioning Pitfall

Dialog	Analysis
<b>BND:</b> Jantien ik heb slecht nieuws voor je. We moeten je gaan ontslaan.	
<b>BNR:</b> Mij ontslaan? Dat kan echt niet hoor. Wacht even, kijk, ik weet, ik heb om die salarisverhoging gevraagd. Als dat het grote punt is dan laten we dat gewoon zitten. Dan houden we het gewoon zo als het was. Ik weet dat dat een belangrijk element was, en die cursus wil ik ook zelf betalen, dat is geen probleem.	Angry emotion, Planning coping, Denial coping
<b>BND:</b> Dat wilde je wel graag doen natuurlijk ja.	
<b>BNR:</b> Maar jij wilt mij toch ook houden of niet?	
<b>BND:</b> Ik had het ook graag anders gezien natuurlijk	Bargaining pitfall
<b>BNR:</b> Met die cursus erbij kom ik natuurlijk ook meer beslagen ten ijs, dus als we het dan zo doen?	Planning coping
<b>BND:</b> Wacht even, dat gaat me iets te snel.	
<b>BNR:</b> Nee, maar met dat salaris dat scheelt natuurlijk een hoop. Daar heb je helemaal gelijk in. We doen het gewoon zo.	
<b>BND:</b> Ik kan er wel even naar kijken.	
<b>BNR:</b> Geef het nou maar gewoon door, daar komen we wel uit.	
<b>BND:</b> Het lijkt me toch goed om even nu ...	
<b>BNR:</b> Ja ik snap dat je er aan moet wennen, laat het maar even zakken dan praten we er later verder over.	
<b>BND:</b> Het is mooi dat je van alles wilt inleveren, en dat waardeer ik ook aan je	

<b>BNR:</b> Ja, en ik werk ook hard voor het bedrijf en dat vind jij ook belangrijk.	
<b>BND:</b> Dat vind ik een mooie kwaliteit ja	
<b>BNR:</b> Dus dan doen we het gewoon zo	

Table 13: Case 5: Bad News Conversation with Bargaining Pitfall

Dialog	Analysis
<b>BND:</b> Hoi Jantien, ik heb slecht nieuws. Ik moet je ontslaan.	
<b>BNR:</b> Ah nee, dat kan je niet menen. Dat kan je echt niet doen, alsjeblieft! Ik heb die baan nodig, ik heb een hypotheek, ben net gescheiden. Ik kan mijn kinderen toch niet op straat laten slapen?	Disbelief emotion, sad emotion, seeking social support coping, planning coping
<b>BND:</b> Nee dat snap ik. Dat gaan we oplossen. Maak je geen zorgen. Ik snap dat dit een vervelende mededeling is, maar we gaan er alles aan doen om je zo snel mogelijk ergens anders aan de gang te laten gaan.	
<b>BNR:</b> Nee ik heb zoveel ellende gehad	
<b>BND:</b> Ja ik zie wat dit met je doet en dit wil ik niet op mijn geweten hebben. Ik ga mensen bellen, je krijgt referenties van me. Dat financiële komt ook in orde. Ik denk dat het zo'n vaart niet loopt, maar mocht je in de problemen komen dan kom je bij me terug he.	
<b>BNR:</b> Ja dat is goed, maar jij regelt met voor me?	Planning coping
<b>BND:</b> Ja natuurlijk, ik ga er alles aan doen	
<b>BNR:</b> Oke gelukkig, want anders word ik gek.	

Table 14: Case 6: Bad News Conversation with Bargaining Pitfall

## B Questionnaire

The questions that are used for analysis sorted per construct. The unreliable questions are removed.

### **Replayability construct:**

- Elke keer dat ik het spel opnieuw speelde was een nieuwe ervaring.
- Er zijn meerdere karakters in het spel. Dit zorgt ervoor dat er meer verhaallijnen in het spel zitten.
- Als ik het spel 6 keer met hetzelfde karakter had gespeeld had ik net zoveel ervaringen opgedaan.
- Ik wil het spel nog een keer spelen.
- Ik vond het steeds minder leuk worden om het spel te spelen.
- Het spel heeft een goede herspeelbaarheid.

### **Believability construct:**

- De werknemers gedroegen zich als een echt persoon.
- De werknemers kwamen op mij over als een simpel computerprogramma.
- De werknemers zeiden dingen die niet logisch in het gesprek passen.
- De werknemers negeerden wat ik tegen ze zei.
- De werknemers sprongen van de hak op de tak.
- Het gedrag van de werknemers in een conversatie was coherent (logisch en samenhangend).
- Het gedrag van de werknemers was zo voorspelbaar dat ik wist wat ze gingen zeggen.
- De werknemers hebben een persoonlijkheid.

### **Immersion construct:**

- Ik leefde mee met de werknemers.
- Ik voelde me emotioneel gehecht aan de werknemers.
- Ik was benieuwd hoe de dialoog zou verlopen.
- Ik vond het leuk om het spel te spelen.
- Het was alsof ik een conversatie had die ik ook zo in het echt zou kunnen voeren.
- Ik deed mijn best om het slechte nieuws op een zo goed mogelijke manier te brengen.
- De (re)acties van de werknemers kwamen overeen met wat ik verwachtte dat de werknemers gingen zeggen.

### Emotion - Personality construct:

- De werknemers gedroegen zich als een echt persoon.
- De werknemers hebben een persoonlijkheid.
- De werknemers konden duidelijk hun emotie uiten.
- Ik voelde me emotioneel gehecht aan de werknemers.
- Ik leefde mee met de werknemers.

## C Content Creation Roadmap

Step	Example
Determine a general goal for the NPC	Create goal: feelWelcome
Add a desire player and NPC agents	Add desire for NPC: greet
Determine whether a desire is a reaction or not	Yes
Set the requirements for the desire to become active	When NPC beliefs that the conversation has just started
Set the requirements for the desire to become inactive when the desire is not a reaction	Not applicable
Determine the actions or events that can be chosen when this desire is active	Hi!
Determine the preconditions for this action or event	Emotion angry is low, belief welcomed is true
Determine which percepts the other agent perceives after this action or event	Welcomed
Determine which beliefs will be updated based on this percept (add new beliefs if necessary)	Set feelWelcome to 0.5

## References

- [1] J. Alvarez, D. Djaouti, *et al.*, “An introduction to serious game definitions and concepts,” *Serious Games & Simulation for Risks Management*, vol. 11, pp. 11–15, 2011.
- [2] P. Lankoski, “Character design fundamentals for role-playing games,” *Beyond Role and Play*, pp. 139–148, 2004.
- [3] W. F. Baile, R. Buckman, R. Lenzi, G. Glober, E. A. Beale, and A. P. Kudelka, “Spikes—a six-step protocol for delivering bad news: application to the patient with cancer,” *The oncologist*, vol. 5, no. 4, pp. 302–311, 2000.
- [4] C. Gillotti, T. Thompson, and K. McNeilis, “Communicative competence in the delivery of bad news,” *Social Science & Medicine*, vol. 54, no. 7, pp. 1011–1023, 2002.

- [5] J. M. Shaw, R. F. Brown, and S. M. Dunn, "A qualitative study of stress and coping responses in doctors breaking bad news," *Patient education and counseling*, vol. 91, no. 2, pp. 243–248, 2013.
- [6] L. M. Ong, J. C. De Haes, A. M. Hoos, and F. B. Lammes, "Doctor-patient communication: a review of the literature," *Social science & medicine*, vol. 40, no. 7, pp. 903–918, 1995.
- [7] A. L. Back, R. M. Arnold, W. F. Baile, K. A. Fryer-Edwards, S. C. Alexander, G. E. Barley, T. A. Gooley, and J. A. Tulsky, "Efficacy of communication skills training for giving bad news and discussing transitions to palliative care," *Archives of internal medicine*, vol. 167, no. 5, pp. 453–460, 2007.
- [8] R. Buckman, *How to break bad news: a guide for health care professionals*. JHU Press, 1992.
- [9] D. T. Wagener, *Slecht nieuws: Een handreiking bij de gespreksvoering*. Reed Business, 2003.
- [10] V. Vinayagamoorthy, M. Gillies, A. Steed, E. Tanguy, X. Pan, C. Loscos, M. Slater, *et al.*, "Building expression into virtual characters," 2006.
- [11] G. Colombetti, "From affect programs to dynamical discrete emotions," *Philosophical Psychology*, vol. 22, no. 4, pp. 407–425, 2009.
- [12] P. Ekman, "An argument for basic emotions," *Cognition & emotion*, vol. 6, no. 3-4, pp. 169–200, 1992.
- [13] P. Ekman and E. L. Rosenberg, *What the face reveals: Basic and applied studies of spontaneous expression using the Facial Action Coding System (FACS)*. Oxford University Press, USA, 1997.
- [14] S. Marsella, J. Gratch, P. Petta, *et al.*, "Computational models of emotion," *A Blueprint for Affective Computing-A sourcebook and manual*, vol. 11, no. 1, pp. 21–46, 2010.
- [15] C. M. Whissell, "The dictionary of affect in language," in *The measurement of emotions*, pp. 113–131, Elsevier, 1989.
- [16] J. A. Russell, "Measures of emotion," in *The measurement of emotions*, pp. 83–111, Elsevier, 1989.
- [17] A. Ortony, G. L. Clore, and A. Collins, *The cognitive structure of emotions*. Cambridge university press, 1990.
- [18] C. A. Smith, R. S. Lazarus, *et al.*, "Emotion and adaptation," *Handbook of personality: Theory and research*, pp. 609–637, 1990.
- [19] J. Dias, S. Mascarenhas, and A. Paiva, "Fatima modular: Towards an agent architecture with a generic appraisal framework," in *Emotion modeling*, pp. 44–56, Springer, 2014.
- [20] S. C. Marsella and J. Gratch, "Ema: A process model of appraisal dynamics," *Cognitive Systems Research*, vol. 10, no. 1, pp. 70–90, 2009.

- [21] P. Gebhard, “Alma: a layered model of affect,” in *Proceedings of the fourth international joint conference on Autonomous agents and multiagent systems*, pp. 29–36, ACM, 2005.
- [22] A. Popescu, J. Broekens, and M. Van Someren, “Gamygdala: An emotion engine for games,” *IEEE Transactions on Affective Computing*, vol. 5, no. 1, pp. 32–44, 2014.
- [23] P. J. Corr and G. Matthews, *The Cambridge handbook of personality psychology*. Cambridge University Press Cambridge, UK:, 2009.
- [24] W. Revelle and K. R. Scherer, “Personality and emotion,” *Oxford companion to emotion and the affective sciences*, pp. 304–306, 2009.
- [25] H. J. Eysenck, “Biological dimensions of personality.,” 1990.
- [26] R. Larsen and D. M. Buss, *Personality psychology*. McGraw-Hill Publishing, 2009.
- [27] R. R. McCrae and O. P. John, “An introduction to the five-factor model and its applications,” *Journal of personality*, vol. 60, no. 2, pp. 175–215, 1992.
- [28] K. Van den Bosch, A. Brandenburgh, T. J. Muller, and A. Heuvelink, “Characters with personality!,” in *International Conference on Intelligent Virtual Agents*, pp. 426–439, Springer, 2012.
- [29] J. A. Penley and J. Tomaka, “Associations among the big five, emotional responses, and coping with acute stress,” *Personality and individual differences*, vol. 32, no. 7, pp. 1215–1228, 2002.
- [30] M. Y. Lim, J. Dias, R. Aylett, and A. Paiva, “Creating adaptive affective autonomous npcs,” *Autonomous Agents and Multi-Agent Systems*, vol. 24, no. 2, pp. 287–311, 2012.
- [31] E. André, M. Klesen, P. Gebhard, S. Allen, and T. Rist, “Integrating models of personality and emotions into lifelike characters,” in *Affective interactions*, pp. 150–165, Springer, 2000.
- [32] S. Kshirsagar, “A multilayer personality model,” in *Proceedings of the 2nd international symposium on Smart graphics*, pp. 107–115, ACM, 2002.
- [33] H. Prendinger and M. Ishizuka, “Let’s talk! socially intelligent agents for language conversation training,” *IEEE Transactions on Systems, Man, and Cybernetics-Part A: Systems and Humans*, vol. 31, no. 5, pp. 465–471, 2001.
- [34] T. Rist and M. Schmitt, “Avatar arena: An attempt to apply socio-physiological concepts of cognitive consistency in avatar-avatar negotiation scenarios,” in *Proceedings of AISB’02 Symposium on Animated Expressive Characters for Social Interactions*, pp. 79–84, Citeseer, 2002.
- [35] R. S. Lazarus, “Psychological stress and the coping process.,” 1966.
- [36] C. S. Carver, M. F. Scheier, and J. K. Weintraub, “Assessing coping strategies: a theoretically based approach,” *Journal of personality and social psychology*, vol. 56, no. 2, p. 267, 1989.



- [37] S. Marsella and J. Gratch, “Modeling coping behavior in virtual humans: don’t worry, be happy,” in *Proceedings of the second international joint conference on Autonomous agents and multiagent systems*, pp. 313–320, ACM, 2003.
- [38] “Your dictionary.”
- [39] T. Bosse and S. Provoost, “Integrating conversation trees and cognitive models within an eca for aggression de-escalation training,” in *International Conference on Principles and Practice of Multi-Agent Systems*, pp. 650–659, Springer, 2015.
- [40] M. N. Huhns and M. P. Singh, “Cognitive agents,” *IEEE Internet computing*, vol. 2, no. 6, pp. 87–89, 1998.
- [41] J. Togelius, G. N. Yannakakis, S. Karakovskiy, and N. Shaker, “Assessing believability,” in *Believable bots*, pp. 215–230, Springer, 2013.
- [42] J. Krall and T. Menzies, “Aspects of replayability and software engineering: Towards a methodology of developing games,” *Journal of Software Engineering and Applications*, vol. 5, no. 07, p. 459, 2012.
- [43] L. Andresen, D. Boud, and R. Cohen, “Experience-based learning,” *Understanding adult education and training*, vol. 2, pp. 225–239, 2000.
- [44] R. C. Schank, T. R. Berman, and K. A. Macpherson, “Learning by doing,” *Instructional-design theories and models: A new paradigm of instructional theory*, vol. 2, pp. 161–181, 1999.
- [45] M. Zyda, “From visual simulation to virtual reality to games,” *Computer*, vol. 38, no. 9, pp. 25–32, 2005.
- [46] D. A. Bowman and R. P. McMahan, “Virtual reality: how much immersion is enough?,” *Computer*, vol. 40, no. 7, 2007.
- [47] A. Sowndararajan, R. Wang, and D. A. Bowman, “Quantifying the benefits of immersion for procedural training,” in *Proceedings of the 2008 workshop on Immersive projection technologies/Emerging display technologies*, p. 2, ACM, 2008.
- [48] R. Buckman, “Breaking bad news: why is it still so difficult?,” *British medical journal (Clinical research ed.)*, vol. 288, no. 6430, p. 1597, 1984.
- [49] A. Molinsky, “5 key mistakes when delivering bad news,” 2016.
- [50] B. Van Straalen, D. Heylen, M. Theune, and A. Nijholt, “Enhancing embodied conversational agents with social and emotional capabilities,” in *Agents for Games and Simulations*, pp. 95–106, Springer, 2009.
- [51] A. D. Andrade, A. Bagri, K. Zaw, B. A. Roos, and J. G. Ruiz, “Avatar-mediated training in the delivery of bad news in a virtual world,” *Journal of palliative medicine*, vol. 13, no. 12, pp. 1415–1419, 2010.
- [52] F. Tencé, C. Buche, P. De Loor, and O. Marc, “The challenge of believability in video games: Definitions, agents models and imitation learning,” *arXiv preprint arXiv:1009.0451*, 2010.

- [53] E. Brown and P. Cairns, “A grounded investigation of game immersion,” in *CHI’04 extended abstracts on Human factors in computing systems*, pp. 1297–1300, ACM, 2004.
- [54] I. Discovery, “Insights discovery colour energies.”
- [55] T. Works, “The benefits of the insights colour model.”
- [56] A. Egges, S. Kshirsagar, and N. Magnenat-Thalmann, “Generic personality and emotion simulation for conversational agents,” *Computer animation and virtual worlds*, vol. 15, no. 1, pp. 1–13, 2004.
- [57] A. Mehrabian, “Analysis of the big-five personality factors in terms of the pad temperament model,” *Australian journal of Psychology*, vol. 48, no. 2, pp. 86–92, 1996.
- [58] D. Livingstone, “Turing’s test and believable ai in games,” *Computers in Entertainment (CIE)*, vol. 4, no. 1, p. 6, 2006.
- [59] E. Bevacqua, R. Richard, and P. De Loor, “Believability and co-presence in human-virtual character interaction,” *IEEE computer graphics and applications*, vol. 37, no. 4, pp. 17–29, 2017.
- [60] P. Gomes, A. Paiva, C. Martinho, and A. Jhala, “Metrics for character believability in interactive narrative,” in *International Conference on Interactive Digital Storytelling*, pp. 223–228, Springer, 2013.
- [61] C. Jennett, A. L. Cox, P. Cairns, S. Dhoparee, A. Epps, T. Tijs, and A. Walton, “Measuring and defining the experience of immersion in games,” *International journal of human-computer studies*, vol. 66, no. 9, pp. 641–661, 2008.