DEPARTMENT OF INFORMATICS

TECHNICAL UNIVERSITY OF MUNICH

Bachelor's Thesis in Informatics: Games Engineering

Interactive Storytelling and Emotions

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Interaktives Geschichtenerzählen und Emotionen

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Submission Date:	15.05.2020

I confirm that this bachelor's thesis in informatics: games engineering is my own work and I have documented all sources and material used.

Munich, 15.05.2020 Julius Krüger

Abstract

Humans have been telling each other stories for a long time and one important aspect of storytelling has always been emotion. With modern technology we are now able to tell interactive stories in which the recipient becomes an active participant of the story. Video games are one application for interactive storytelling. We will review their storytelling capabilities and explore why emotions are an important aspect of video games and their narratives. We propose an emotion engine that allows game components to react to events in an emotionally believable way and allows the author to convey the desired emotional meaning of the story to the player through the game's representation. The emotion engine uses an emotion model that is based on the emotion theories by different researchers as well as on computational models of emotion.

Contents

1 Introduction

Emotions are an integral part of the human experience. Aristotle already suggested that emotions play an important part in storytelling [1]. Most good stories make use of the human capacity to emphasize with the characters we read about or see on screen, ultimately eliciting emotions in us. With the advent of the computer a new medium has joined the ranks of storytelling media. Video games allow us to tell stories in which the reader becomes an active participant in the story. Rather than merely emphasizing with the characters of the story, the player usually takes control of the protagonist and becomes an active participant in the story.

This allows games to be one of the most immersive storytelling media out there. Nonetheless, the range of emotions in video game narratives appears to be very narrow [2]. Games often don't react to events that occur in them in an emotionally coherent and believable way. A non-player character might be offended when the player insults them, but not even a minute later they already forgot and act like nothing happened rather than responding emotionally. Occurrences like this often break the player's immersion, diminishing the entire experience in the process.

Research regarding the application of emotions in video games focus for the most part on improving the behavior of agents through emotionally consistent behavior, making the agents more realistic in the process [3]. The application of emotions theories has also been attempted through user modeling. In these cases the emotions currently felt by the user are guessed the interactive storytelling system. Based on that, the story can then either be altered to fit the player's emotions or the representation of the story can be altered to fit an emotional state, just to name two examples [4], [5]. This thesis aims to lay the theoretical foundation for an emotion engine, which allows us to have an emotional response to the events generated by the player, other characters, or the story. In theory this should allow us to create better narrative experiences in video games through deep, believable characters, and the representation of emotions conveyed by the story or an event through some of the game's components.

Before we can develop such as system we should have a notion of what video games are, how they work and why emotions are even relevant for video games. We also need to understand what a story is in general and how we can combine narrative and interactivity, which some consider to be at odds with each other. We will especially focus on the different ways video games use to tell their stories and how emotions are

currently used in interactive storytelling. We will then delve into the psychological background of emotions and examine the different perspectives on why humans have emotions and how they are elicited. Further, we look at the *EMA* [6] and the *MAMID*[7] computational models of emotion, which simulate the emotion response process from an event to a coping action. Both models are based on psychological emotion theories. Ultimately, we propose an emotion engine and a model of emotion to be used with it. The engine allows game components to react to events in an emotionally believable way and allows the author to convey the desired emotional meaning of the story to the player through the game's representation.

2 Related Work

We can find existing work regarding the issue in several research fields. If we want to develop a system that helps us to represent the emotional content of an interactive experience as well as improve the emotional responses of agents, we first need to understand why humans have emotions and how they arise. There are several different perspectives on how and why emotions are elicited. The discrete theory of emotion considers emotions as biologically innate and universal in all humans regardless of culture. Only a few fixed basic emotions exist in these theories. All other emotions are variations of a corresponding basic emotion. One such theory was proposed by Ekman [8]. Then there is the dimensional theory of emotion, which views emotions in a continuous spectrum in two or more dimensions, instead of discrete categories. One such theory is the *Circumplex Model of Affect* [9] as proposed by Russel. The model maps all emotions onto a circle in a two-dimensional space formed by the dimensions pleasure and arousal. The seemingly most popular theory of emotion, at least among computer scientists, is the appraisal theory of emotion, which views the process in which emotions arise as cognitive. One important appraisal theory was developed by Smith and Lazarus [10]. Another important contribution to the field of appraisal theories was made with the *OCC model* [11], which was designed with the purpose of laying the foundation for a computational model of emotion.

Computational models of emotion adapt the theories of emotion into a framework that allows for the simulation of emotions in agents. The *EMotion and Adaptation* [6] model is based on the appraisal theory by Smith and Lazarus [10], but also considers other affective states. *MAMID* is also based on an appraisal theory of emotion, and considers personality traits in addition to other affective states, such as mood, which are presented similar to core affect by Russel [12].

Emotion research has already found its way into the domain of video games as well as interactive storytelling. Some researchers have used computational models of emotion to develop systems that are intended to make the agents we find in games act emotionally coherent and more believable than the state of the art in currently available commercial games. Such systems include *GAMYGDALA* [3], a black-box emotion engine, or the model for the *Simulation of the dynamics of non-player characters* developed by Ochs et al [13]. Others have integrated emotion research to model a user and then have the story react to the emotional state of the user. In [5] a viewer watches

a video and is given the choice to respond how they would feel if they were in the character's shoes at several points of the story. Depending on the viewer's choice the video continues one way or another. In [4] a video game was developed. Here the player can make minor and major choices regarding the story and the interaction with the game's environment. Depending on the player's choices the game responds by changing the representation of the game to convey a different emotional meaning.

3 Games

Jesse Schell suggests in [14] that games can be split into four components. Aesthetic, mechanics, technology, and story. These components all need to support each other in order to create a coherent experience. Aesthetics define how the game looks and sounds and can have considerable emotional impact on the player experience as well as their emotions.

When aesthetics, story and technology are removed, the interactions and relationships that remain at the core of the game are the mechanics. They differentiate games from more traditional media such as books and film. They define the behavior and rules of the game; the goals the player has to achieve as well as what methods the player can and cannot use in order to reach said goals [14]. The player interacts with the game through mechanics and in doing so they generate events [15]. Many components of the game can be considered mechanics. Objects, for example, are components the player can interact with and can be considered the nouns of mechanics. They influence the amount of agency a player can feel during play. A game that enables the player to create or modify any object to their liking obviously offers a lot of freedom to the player. At the same time the designer is restricted in the amount of narrative control they can exert over the game [16]. Another component that is mechanical in nature is the space in which the game takes place. Space should be divided, however, into the ludic space, which is part of the gameplay and the mechanics as well as the extra-ludic space, which is the space that surrounds the ludic space, but the player can't interact with in terms of gameplay, but acts as a storytelling device nonetheless [16]. Either type of space has narrative meaning and is influenced by the game's story. Mechanics also contain the actions the player can take, such as walking or shooting [14]. These are often seen as the verbs of gameplay. All the different aspects that are part of mechanics can only happen in the context of rules, arguably the most important mechanic. The rules define what the player has to do in order to win or lose. By defining these conditions, rules impose a frame on the other mechanics in which they operate [14].

Space, objects, by extension characters, and events are all important aspects of a game's mechanics, but we can find all of these in stories as well [16]. The story of a game describes the sequence of events that happen in the game and allows the players to put their actions into context. It gives their actions meaning, which helps them understand what they are doing, and why they are doing it [2]. The world, and

therefore the mechanical space of a game, is influenced by the narrative. The setting, history, and characters a player will find in the game's world are determined by the narrative [17]. Since the world, to a degree, is tied to the mechanics it has concrete measures and can be explored by the player as well as other agents that inhabit it. This sets the worlds of games apart from those we might find in books or other more traditional types of media [16]. The characters we find in games are often simpler than those we find in books or even movies. Especially the characters controlled by the player are often focused on physical struggles, rather than emotional ones as we might find in a book [14]. This is owed to the interactive nature of games, where the player might project their own emotions onto the character and the fact that we don't hear the thoughts of the character for the most part. Player characters can be blank slates onto which the player can fully project themselves, with the character acting on their behalf. Characters can also be entirely fixed, here the player controls the character during gameplay, but for narrative purposes the character is still independent from the player, rather than a projection of them. Alternatively, some games give the player the option to customize their character. Here the player is able to choose the appearance, or background story of their character, and might even be able to define the character's personality through gameplay actions or dialogue options [17]. Non-player characters (NPCs) roughly fall into three categories. In games, these types of characters can be bots that populate the world and occasionally oppose the player. Bots have no personality of their own. There are shallow characters that have names and an individual appearance, but still only some notion of personality. Then there are deep characters with their own goals and personality. For the most part the first two types of characters prevail in games [16].

3.1 Emotion

Video games are experiences which combine many different disciplines. Many of these disciplines can evoke emotion and so video games are full of emotional triggers. Visual images elicit different emotions depending on which colors an artist used. Music and sound are very powerful tools when it comes to creating emotion. The sound of nails scratching on a blackboard, for example, is found to be irritating by many people. We are able to experience emotion through challenge, learning, narrative, and social interaction [15]. Even physical environments can evoke emotion in us and it has been suggested that the degree of order and variation decides whether we perceive an environment as harmonious or disharmonious [18].

Imaginary events, depicted by art, film, or video games, can evoke emotions in us. These emotions are not real. We realize that we are not, for example, in a life

threatening situation, unlike the hero we are watching narrowly escape death on screen. The underlying changes in what Russel calls core affect, an important part in the emotional response, appear to be real, however. We don't take instrumental action, because core affect seems to be not sufficient for that [12]. Nonetheless, our emotional response to these imaginary events can be very strong and even result in expressions such as crying or dominate our action control. When we watch a suspenseful movie scene we might tense up, but we don't engage in a full fight or flight reaction [19]. Being able to experience the same emotions in an imaginary situation, we would experience in the real situation helps us to understand how an imagined event would make us feel [12].

We can differentiate between two kinds of emotion when perceiving art. The emotions that are elicited by the work of art through its structure. For example the most beautiful piece of music, composed of the perfect combination of melody, harmony and rhythm, that makes one cry [19]. Then there are the emotions we ultimately experience due to empathy. Humans are empathetic creatures and we are able to feel with other human-beings whether they experience joy, sadness or pain. We are also able to understand that when we watch a movie or play a video game we experience an illusion; and within that illusion we can accept any event as what it is presented to us. This allows us to also feel with the characters of a story the same way we would with real human being [15], [19] Traditional narratives as we find in books and films can use this to very carefully construct a story. The story unfolds the same for every audience and ideally evokes the same emotions. This can be more difficult for games, especially when they are, for example, telling branching stories. Narratives can evoke a range of emotions in us and they can also be a motive for players to engage with video games in the first place.

There are many reasons for playing video games and different people have different kinds of motives for playing. These different motives can be linked to, and might even find their origin in, emotion [20]. Motives can be split broadly into categories with some overlap. The thrill-seeking, social and curiosity motives are all considered to be general motives and as such concern very general aspects of life and emotions on a basic level. Thrill-seeking, simply refers to the pursuit of excitement, which is considered to be a positive emotion. Curiosity, although not strictly an emotion, is similar to the emotion of wonder, which also leads to awe if combined with fear [20]. Then there are functional motives, such as the victory, the problem-solving, the acquisition and the luck motive. The victory motive for example especially concerns players who are attracted to challenge. The challenge forces the player to endure anger and frustration for a while until the challenge is overcome. This in turn rewards the player with the emotion of 'fiero', a very specific positive emotion we feel once we accomplish a difficult task [21]. Similar to the victory motive, the problem-solving motive can also cause

'fiero' or less intense positive emotions in a player. The circumstances, under which the emotion arises, is different, however. Rather than enduring frustration and overcoming a challenge, the player endures a state of confusion. Once the player solves, for example, the puzzle, the confusion is resolved and the player experiences the positive emotion. At last, there are representational motives. These are the narrative motive, which we already mentioned earlier, the horror, and the agency motive. Horror exposes us to emotions such as fear and disgust, but allows us to ultimately enjoy the experience. We realize the situation is not real, yet we accept the illusion. The agency motive concerns the positive emotions we derive from simply interacting with the game and being able to recognizably impact the events of the game [20]. Agency refers to the degree of control the player feels they have in the game by making decisions that meaningfully affect the world of the game.

4 Interactive Storytelling

Since the emergence of video games there has been an ongoing debate whether interactivity and storytelling are at odds with each other or whether they can be reconciled. Before we can get into that it would be beneficial to define the words 'story', 'plot' and 'narrative'. A 'story' can be considered as information about an event or a sequence of events, which is generally ordered in a linear fashion. The 'plot' describes the way in which these events are linked and the reason why they happened. The 'narrative' refers to the unique way in which a story is presented to the audience. The presentation differs depending on the medium that is used to tell the story. For video games an argument can be made that gameplay is part of the narrative, since it is part of the representation [22].

Stories usually feature characters, one of which is the protagonist. In most stories the protagonist lives their normal life, but are the confronted with a problem, which they have to solve over the course of the story. In a STEREOTYPICAL story the process of solving the problem the protagonist overcomes a series of obstacles, learn something about themselves and experience personal growth. Towards the end of the story it often seems as if the protagonist failed in solving the problem, but eventually they are successful [23].

Traditional stories are crafted carefully by an author, and are then experienced by a, somewhat passive, audience. Although, the experience of the story can change from recipient to recipient, the story always stays the same in it's representation. The audience reads the same words in the same order, or sees the same pictures framed the same way and experience the same story beats at the exact same point in the story every time they 'read' the story [24].

An interactive narrative system on the other hand allows each recipient to experience a unique story every time the story is told. Instead of crafting the story, the author creates a world, populated with characters that can by affected by external events. The story the user experiences is generated by their interaction with and the decisions they can make in the world and the characters in it [24].

A problem with interactive narrative is what is referred to as the narrative paradox. The narrative paradox states that the pre-authored nature of traditional stories and their narrative conflicts with the freedom of action and interactive characteristics that we find in video games or similar interactive environments [25]. To deal with this problem

of interactive narrative two schools of thought have developed related to interactive narrative systems.

The author-centric school has an author set up a world in which the story takes place, it's characters, and an intended story arc. The characters are controlled by a drama manager that tries to guide the user so their experiences matches that of the specified story arc. This way the author stays in control over the story to some degree and can ensure the coherence of the plot. The user has the freedom to take actions and make decisions. However, the believability of the characters might suffer when the purpose of the actions they take is primarily to guide the player towards a certain story arc [24].

The character-centric school also lets the author set up the world, however, once set up the world and it's characters run without any influence by the author. The story then emerges only from the interaction between the user and the characters. This allows for strong believability from the characters, but it is possible for the plot to be incoherent. In the worst case the story would bore the user, because believable characters that behave similar to real people do not necessarily make for a good story [24].

4.1 Storytelling in Video Games

One application of interactive storytelling can be found in video games. Some have argued in the past that video games are not a storytelling medium, but if we take a closer look at what narrative is and how it might be applied to video games we can see that's not necessarily true [16]. For one, video games and stories share a number of elements, which they order. The world, it's characters and objects and events. The narrative concept of kernels and satellites also helps when we want to talk about video games in terms of narrative. Kernels are the core elements of a story that make a particular story what it is. Changing a kernel, changes the story fundamentally to the point that it becomes a different story. Satellites are events that shape the representation of a story. They can be changed and the story, at it's core, still remains the same [26]. A kernel would be the big, bad wolf trying to blow the houses of the three little pigs away. If instead they invited him in to play backgammon that would be a very different story. A satellite would be whether the wolf dies at the end or runs away, never to be seen again. This doesn't change the story at it's core. The third pig keeps its house and the wolf won't bother it anymore. Only the representation of the wolf not bothering the pig anymore is changed. Aarseth suggests in [16] that the combination of kernels and satellites defines the type of story a game presents to it's audience. A game with static kernels and satellites, meaning neither can be changed during the experience, would actually not be a game at all, since static kernels and satellites do not allow for any interactivity. It would be a pure story. A game with dynamic satellites would be a

linear story, which can be played. The story sequences are fixed, but how the player gets there is determined by how they play the game. A game with dynamic kernels would be a branching narrative and a game without any kernels would be a pure game without a dedicated story [16]. However, even a pure game can convey meaning and narrative through gameplay.

4.1.1 Narrative Structures

The idea that stories have an underlying structure can be traced back to Aristotle, who already proposed that a story could be split into two acts. Over the centuries different act structures have been popular. Currently the three-act structure is quite popular as most films are based on it. The three-act structure has been adapted to be used in games and is together with the hero's journey one of the most commonly used structures in video games [1], [2].

The three-act structure divides a story into three acts. The first act is the setup, it introduces us to the characters and ends by presenting a problem to the main character they have to overcome. This leaves the audience with the question whether the main character will achieve their goal or not. The second act, the confrontation, shows the main character's attempts to solve the problem, but ultimately they fail and potentially worsen the situation. The final act is the resolution of the story. The problem is overcome and the question asked in the first act will be answered [23].

The Hero's Journey, or monomyth, is another narrative pattern that can be found in many games. The structure divides the story into twelve steps. The hero's journey can also be divided into three acts. The first consists of the departure. The hero who resides in the ordinary world is called to action, and often reluctantly follows that call. The second act, called the initiation, follows the hero on their journey to a new world. Here the hero overcomes or finds the solution to their problem. In the final act, the return, the hero has to journey back to the ordinary world [27].

Stories that feature the traversal of a space by the main character such as the hero's journey can be considered spatial stories [28]. The traversal of space seems to be an important aspect of many video games. Patterns such as the hero's journey lend themselves very well to tell stories in video games, because a journey and overcoming obstacles on the journey is the premise of many video games in terms of gameplay.

Not all games follow structures like the hero's journey or the three-act structure rigidly, if at all. It has been argued [29] that games don't really need a structure at all as characters are more important. However, structures such as the hero's journey, the three-act, or any-kind-of-number-structure really, ensure that a story follows an interest curve, at least to a certain degree. Interest curves are important for any kind of experience and play an important part in keeping us engaged [14].

Linear Narratives

The linear structure, sometimes called the string-of-pearls, is still one of the most commonly used narrative structures that can be found in video games [22]. Here a non-interactive story event is presented to the player, which is then followed by an interactive part of gameplay. During the gamplay section the player has the amount of freedom and control conceded to them by the game's mechanic. Once the player reaches the goal of the gameplay section they are rewarded with the next piece of non-interactive story content [14]. The order of linear narratives is pre-authored and the player has no influence over the progress of the story [24].

Branching Narratives

Another, arguably more interactive, structure for video game narratives is the branching structure. At certain points of the story the player is given the opportunity to make decisions that influence the further course of the story. This grants the player a higher degree of freedom and control over the story, which allows the player to feel a higher sense of agency [22]. In a pure branching structure every decision made by the player leads to a unique outcome of the story [24].

The problem with this kind of story is that a truly branching story needs a lot of content to be generated, most of which a large number of players probably will never see. At every branch the story splits into at least two different story arcs, which should both lead to a unique ending. This quickly amounts to a huge number of different endings. To make branching feasible some games only branch into paths periodically for a sequence of the game, only to merge these branches back into one at a later point. This limits the number of endings, reducing the amount of content needed, but at the same time allows the player to feel more in control over the outcome of the story [17], [24].

The different endings required for a branching narrative lead to another problem. Stories are often crafted with a theme in mind and every decision made by the author reinforces that theme to create a coherent story. With different endings the theme and unity of the story is disrupted, resulting in an ultimately weaker story or at least a number of weaker endings that might leave players disappointed [14].

Open Narratives

Another structure, and basically the opposite of the linear narrative, is the open narrative, which some games use. Here the narrative is often structured by quests, self-contained units of story content with their own story arc. The player can freely choose which quest to pursue and can even switch between mid-way through the story

arc. This allows the player to experience a high amount of agency as they can choose how they want to approach the content of the game [17].

4.1.2 Dialogue

Similar to other narrative media video games can convey narrative through dialogue. The dialogue in video games can serve multiple purposes. It can be used as a characterization device, allowing the player to understand the motivations of non-player characters or the player character better. Dialogue can help flesh out the world of the game or provide the player with breaks in between sequences of gameplay, thereby helping the pacing of the game. The types of dialogue that can be found in video games can be broadly categorized into three categories. Ambient dialogue, which is non-interactive, but does not interrupt gameplay. This type often provides the player with additional information about the game world or their current situation. The player can choose to ignore this type of dialogue, if they are not interested in it. Video games allow for interactive dialogue where players can pick from pre-authored dialogue options how to respond in a conversations. With this type of dialogue players can often engage in role-playing, characterizing their player character to their liking, at least to the extent the game allows. Some games go even further than merely allowing for characterization, but also allow the player to branch the story with the choices they make in interactive dialogue, making their choices more meaningful. The last type of dialogue occurs during cutscenes and is entirely non-interactive [17].

4.1.3 Cutscenes

Cutscenes are a very common device in video games to convey narrative to the player. Most often they are used to explain the story or current events, to transition from a story segment into gameplay or to show the consequences of actions the player has taken [22]. Since they are very similar to film, the same conventions that are applied in films can be borrowed for cutsences. They are often criticized for being a mostly passive narrative device that can disrupt the interactive experience of the player [22]. Especially in linear narratives they are used as a reward for the player after completing a gameplay section. However, if they are used too frequent they can have negative effect on the game's pacing. Cutscenes are commonly used to tell the most important scenes of a game's story [17].

4.1.4 Game Mechanics and Narrative

The game mechanics of video games are an important tool to convey narrative. A distinction can be made between a narrative mechanic and the narrative that is conveyed

through the nature of a mechanic itself. A narrative mechanic is a game mechanic that allows the player to directly influence the story or it's representation by using that mechanic [30]. *Deus Ex Human Revolution* [31], for example, features a sequence where the player has to decide whether one scientist, who could expose a conspiracy, or a prison block full of innocent abductees should be killed by poisonous gas. The player makes this decision by selecting one of two dialogue options. If the player doesn't make the decision before a timer runs out, both, the scientist and the abductees, die. However, if the player uses the mechanics related to exploration of the environment and shooting they can find and destroy the device responsible for distributing the gas, saving both in the process. This in turn influences the story, if only to a minor degree.

The other way game mechanics contribute to the narrative is that mechanics define the kinds of actions the player can take in a game in the first place. By determining how players can interact with the game world and other characters in it, mechanics allow the player to experience certain stories that emerge from those interactions [32]. Most stories involve several characters and actions. The actions the player can take towards other characters or the game world lead to a sequence of events, which is a story by definition. Some of the mechanics act as the verbs that story uses. Depending on the mechanics some stories are more likely to occur through this kind of interaction than others. Together with the other techniques games employ to tell stories, mechanics can help in creating a coherent narrative experience, if the mechanics are designed to support and reinforce the narrative [33].

4.1.5 Emergent Storytelling

Game Mechanics also enable games to tell emergent narratives. These are neither pre-structured nor pre-authored, but instead players author their own narrative. The game acts as an environment that enables this. Games that focus on emergent storytelling often feature non-player characters who have their own goals, needs and urges, and can react to the environment independently. When these characters come into conflict with the player or each other an encounter with narrative value emerges [28]. Aylett suggests that narrative does not have to be authored. Instead it can emerge in virtual environments similar to the stories told by improvisational drama [34].

Aylett suggests that narrative does not have to be authored. Instead it can emerge in virtual environments similar to the stories told by improvisational drama [34]. A lot of the emotional impact of traditionally told stories results from the interaction between different characters. In improvisational drama the performers choose their actions according to the personality, history, and goals of their characters. Similar, it is possible to generate a narrative with intelligent agents in a virtual environment such as a video game. The narrative emerges from the interaction between those agents, and their

emotional reactions to the situations they find themselves in. The depth of the story that emerges from their interaction depends on the richness of the characters and the world they find themselves in. The characters need their own personal backgrounds and goals, as well as a wide range of emotions, moods and personality to support a deep, engaging story [35]. The mere existence of rich characters is not enough to produce a story, however. It also takes external events to which they can react. Otherwise, we might no get any interesting behaviour out of the characters, no matter how rich their background [34]. This is very similar to the requirements of the first act of any story or the hero's journey, where an external event takes the protagonist out of their ordinary life [23]. A problem with this kind of character-based emergent storytelling is that a narrative might simply not emerge, and even if it does the player might miss it or view it from a perspective from which the story might simply not seem that interesting [34].

4.1.6 Environmental Storytelling

The term *environmental storytelling* appears to have been initially coined by Dan Carson in an article on gamasutra, in which he compares video game worlds to theme park attractions. He argues that it is possible to combine spaces with story elements, because elements such as color, lighting or music can evoke emotions and certain expectations in an audience. Combining the spaces of a video game with story elements can further the player's understanding of where they are and what they can expect from the fictional world [36]. In general most objects and structures we can find in an environment suggest something about the location they can be found in. The layout of a city's streets hints towards whether the city was planned or whether it grew organically without much oversight, for example. If the city has walls this might hint at a threat the city faces or faced in the past [15].

An effective way for video games to apply environmental story telling and to pull in the audience is a *cause and effect* vignette [36]. These are areas, which have been set dressed and allow the player to conclude what events have transpired here at some point in the past. These can be used to draw the player deeper into the world, but can also hint at an upcoming threat further down the level. They can be used to depict the passage of time or show the consequences of actions taken by the player. The latter only works if the player returns to a place they had come to know earlier, only to find it changed now.

They are very similar to *embedded narratives*. The most common example for an embedded narrative is the detective story. The environment contains clues about an event that happened in the past and it is the player's task to discover these clues and piece together the information they contain, revealing the story in the process. In these kinds of narrative the player has to actively put the clues together and make

hypotheses about an event that transpired at a place to piece the story together. They use the information provided to them by the game. Here, the story could be seen as a body of information, rather than a temporal construct. The game designer can control the narration to a certain degree by distributing information across the environment. Since the user is able to explore the world on their own it is not guaranteed that they will recognize or even find every piece of information. Therefore, the player needs to be able to acquire the information from more than one source [28]. When narratives are embedded into the environment the player is no longer told the story, but has to construct the story by themselves through interaction with the world or at the least put it together by uncovering the necessary hints in the world. The video game shifts from a storytelling experience for the player to a story-building one [37].

4.2 Emotions in Interactive Narratives

As we have already explored in the previous section emotions also play an important role in video games and our motivation to play them. However, although narrative can elicit nearly any emotion in us, we only find small range of emotions in video game narratives. In 2011 Barry Ip analyzed the narratives of a somewhat representative, but nonetheless very small sample size of video games [2]. Ip used Plutchik's wheel of emotion [38] to classify the emotions found in the games. The wheel uses eight basic emotions with varying intensities. The analyzed games portrayed an average of two emotions per narrative sequence. Most of the emotions portrayed in the game were simple and similar rather than complex and contrasting. Some of the games only used a total of four emotions in their narrative. Most of the game characters were only having extra-personal conflicts and therefore most of the portrayed emotions also relate to extra-personal conflicts. Emotions relating to inner conflicts of the characters appear to be neglected for the most part. This is problematic, because interesting compelling stories usually feature a character, who has to deal with a conflict between their inner and outer selves. The conflict ramps up as the story progresses until it is ultimately resolved [2]. Game narratives lack this contrast between inner and outer conflict. Ip tries to explain the lack of some emotions in game narratives with gameplay, where the emotions lacking in the narrative are experienced during gameplay. The narrative is not just told through the forces acting on the protagonist, but also through the actions performed by the player. The player becomes an active participant in the telling of the story. They decide how a level or puzzle is solved, shaping the narrative through their action during play. [2].

Traditional stories elicit many emotions in us through empathy. We can relate to the characters and because of that we can feel with them and experience similar emotions.

However, the characters we find in video games are often either bots or only very shallow in terms of their personality. This makes it harder to relate to them. If video games were to use more deep characters with a complex personality, who would act similar to real humans, at least on an emotional level, a lot of narrative potential could be unlocked [16].

5 Emotion

All throughout life we experience emotions. Aristotle already tried to define what our emotions are and how they arise in us [39]. Most researchers seem to agree that emotions play an integral part in human existence. They disagree, however, whether emotions are biologically innate in humans and have developed through evolution or shaped by the culture and environment we live in. Some argue for a middle-ground between those to positions. In the following sections we will take a look at some of the different theories of emotion that have developed over the last decades. Furthermore, we will look at how some of these theories have been translated into computational models that can be used to simulate human emotions.

5.1 Mood and Personality

To fully explore the current state of research regarding mood and personality would outside the scope of this thesis. However, both moods and personality are related to emotion and involved in the forming of different emotions [6], [10]. We will consider moods as affective states very similar to emotions. While emotions only last for a short time, moods last longer and are often harder to attribute to a causing event. Moods can be influenced by emotions and experiencing negative emotions while in a happy mood can turn it into a neutral and ultimately into a negative state [6], [12].

We will further assume that personality is based on traits as suggested by the *OCEAN model* or the *three-factor model* [40], [41]. These traits are generally stable over years or even the lifetime of an individual [42]. In both models these traits describe how prone we are to engage in a certain behavior. Both models use the traits *extraversion* (how outgoing or socially reserved and individual is) and *neuroticism* (emotional stability). The *OCEAN model* further uses the *openness to experiences* (the willingness to try new activities), *conscientiousness* (awareness of one's own actions and their consequences) and *agreeableness* (how cooperative one is towards other people) to understand a person's behavior. The *three-factor model* only uses *psychoticism* (level of aggressiveness of an individual) as a third trait. The different personality traits determine different aspects of a persons behavior. The intensity of certain emotions, how quickly an emotion arises, how easily a mood changes state. All of these are influenced by traits.

5.2 Theories of Emotion

Theories of Emotion attempt to explain how emotions arise in us and how they work. The models can be classified into several categories. For the purpose of this thesis we will look into three of them. The discrete or basic emotion theory, the dimensional theory, and the appraisal theory.

5.2.1 Discrete

The discrete or basic theory of emotions argues that there is a fixed set of basic emotions. These emotions are rooted in biology. They are the same for all human beings regardless across different cultural backgrounds and upbringings.

Ekman

One proponent of the discrete theory of emotion is Ekman. He proposed that there are six families of basic emotions. He based this theory on evidence that some emotions seem to be universal in all humans and are innate to us. He argues that these emotions are basic, because they have evolved to allow us to react quickly to fundamental life-taks and interpersonal encounters. Our personal and our history as a species have shaped the how and why we experience these emotions. Emotions can be seen as a shortcut to behavior that has been helpful in the past in certain situations [8].

The six emotion families Ekman proposes are anger, fear, sadness, enjoyment, disgust and surprise. Each family groups together all emotions with a similar theme. The theme groups the characteristics that are unique to a family together. These set it apart from the other families. For example anxiety and panic are both part of the fear family, because they are similar in the underlying systems that lead to their expressions, even though the situations in which each may be elicited is very different. Additionally, families have variations. While theme might be an evolutionary result, variations account for cultural and individual differences in the emotional response such as learning experiences [8].

Ekman uses nine characteristics to distinguish the different families of emotion. Every emotion family needs a *distinctive universal signal*, which mostly refers to a facial expressions that differs distinctly from those of other emotion families. He derives this requirement from evidence that found certain facial expressions to be universal. An emotion family also requires an *emotion-specific physiology*. This is to say that each emotion family require a UNIQUE COMPONENT OF THE BRAIN/NERVOUS SYSTEM that is responsible for the elicitation of a specific emotion family. Another requirement for basic emotions are *universal antecedent events*. The argument here is

that if emotions prepare us to deal with fundamental life tasks and they are biologically innate then the events that elicit these emotions must have at least some common ground that leads to the same emotion even though the context is different. Emotions also need a*quick onset*. If the purpose of emotions is to help us respond to important events with no time to think about a response then the emotion response needs to be fast. These events can occur very rapidly, so emotions need to arise in us very rapidly as well. Otherwise they wouldn't be able to aid our response to these events. Another characteristic is the *brief duration* of emotions. Emotions would not allow for a quick response to rapidly changing events if each emotional response lasted very long. Instead emotions last only for a short time unless they are evoked again. This also makes them distinguishable from moods. He further argues that emotions need *automatic appraisal*. Due to the quick onset of emotions, the appraisal process, which leads to an emotion, must also be very fast. Since we are generally unaware of the appraisal process it must operate automatically. The remaining characteristics are the *presence of the same emotion family in other primates*, a *coherence among emotional responses* and the *unbidden occurrence* of emotions [8].

5.2.2 Dimensional

The dimensional theories of emotion suggest that emotions can not be described as discrete categories, but should instead be viewed in several continuous dimensions. Most models seem to put emotions into two or three dimensions. These theories distance themselves from the idea that emotions are entirely based on biological features, since the evidence that would suggest so is still very limited or even seems to contradict the assumptions made by discrete theorists [43].

Circumplex Model of Affect

With the circumplex model of affect [9] Russel suggested that the different emotions attributed to emotion words can be arranged in a circle in two dimensions. He argues that emotions require three properties to allow for a cognitive representation of them. Pleasure is the first property and the horizontal axis in his model ranging from pleasure as the most positive emotion to misery as the most negative. The second property is arousal, which is used as the vertical axis. It ranges from arousal which has the highest mental activity to sleepiness with the lowest. Pleasure and misery are both considered neutral in their arousal value, while the two extremes on the arousal axes are both neutral on the pleasure scale. Russel argues that a third dimension could be used in a dimensional emotion model, however, the most variance between emotions can be accounted for by pleasure and arousal. A third dimension would add little, and

refers, in most models that use one, to the eliciting event or the consequence of it and does not describe the emotion itself. Therefore, he suggests that the third property can be viewed as a combination of the pleasure and arousal component which allows to classify all remaining emotions [9].

The model uses eight variables on the circle, four of which are the previously mentioned extremes of the dimensions. The other four classify the quadrants and are excitement (high pleasure, high arousal), contentment (high pleasure, low arousal), depression (low pleasure, low arousal), and distress (low pleasure, high arousal). According to Russel every emotion falls somewhere onto that circle depending on the degree of arousal and pleasure. The opposite of an emotion can be found roughly 180 degrees away, on the other side of the circle. In contrast to basic emotion theories, his theory suggests that emotions can't be strictly separated into basic categories. Instead the borders between different emotions are fuzzy. He further suggests that emotion is the end product of a cognitive experience rather than a purely biological response [9].

Russell later admitted that two dimensions are not enough to model all the different emotions humans can experience [12]. Instead he suggested that core affect, perception of affective quality and attributed affect in combination with information processing and behavioral planning are responsible for the construction of any emotional episode.

Core affect is basically the circumplex model, but, unlike previously suggested, the dimensions of pleasure and arousal are not enough to construct most emotional episodes. It is the first primitive in his model. Core affect is more basic than then the circumplex model. It can be considered a foundation for emotions, but also for any other emotion-laden experience, including moods. As a consequence core affect is primitive and universal. It can be experienced in an intense form as emotion, or in a mild form with no clearly identifiable stimulus as a mood. There can be differences in core affect between individuals based on genetics and internal temporary factors, such as hormone levels. The internal factors dictate a baseline upon which outside stimuli are processed. The core affect then depends on all the information an individual possesses about the external cause from the first registration of a stimulus to full cognitive processing. Core affect continuously assesses the current state of an individual. Since it is in part responsible for mood, it tints all other psychological processes based on current core affect. While having positive core affect, experienced events seem more positive [12].

The perception of affective quality is the second primitive in the model. While core affect originates within an individual, the affective quality stems from the stimuli we perceive from an environment. We perceive these stimuli as meaningful objects, which are affectively interpreted. Every object has an affective quality that we perceive and it influences our behavior towards it. The affective quality can be viewed as a representation of core affect [12].

While moods can be considered core affect without an object of reference, emotions require what Russell calls attributed affect. In attributed affect the change in core affect is attributed to an object, which is perceived as the causing entity of the change. The object can imply a meaning or consequence of an event and it has a perceived affective quality. In the model attribution of an object allows for variance in the emotional response due to cultural or individual factors [12].

Russell suggests that the dimensional and discrete view on emotions should be combined to gain a more complete understanding of emotional episodes. Neither biological factors nor social ones are always solely responsible for the sequence of events that results in an emotional episode. An emotional episode is an event that counts as a member of an emotion category such as fear. According to Russel a prototype of a specific emotion is constructed from core affect, the perception of affective quality, attribution to an object, appraisal, action, the emotional meta-experience and emotion regulation. Those components do not depend on each other and can occur on their own. Based on the state of the different components an emotional prototype is picked that matches a mental representation of an emotion the closest. The mental representation is a label which we assign to a specific emotions, for example, happiness [12].

5.2.3 Appraisal Theories

The Appraisal theory of emotion is one of the more recent theories on emotion. Appraisal theories argue that emotions are the result of an ongoing cognitive process in which the current situation of an individual is evaluated. In response to the evaluation an emotion is elicited [44].

Smith and Lazarus

In [10] Smith and Lazarus propose their appraisal theory of emotion, the *cognitive-motivational-emotive system*. They consider appraisal as the evaluation of an event that has an impact on an individuals well-being and therefore causes an emotional reaction. Their model can be seen in figure 5.1

In this theory emotions are the result of cognitive activity. However, they acknowledge that not all cognitive activity is relevant or at least not equally relevant for an emotion response [10].

They split cognition into two distinct types, which are relevant for appraisal. For one, an individual needs to have formed a representation of the relationship they have with their environment. This representation consists of the knowledge and beliefs the individual has about what is currently happening. It is required for emotions, but does not cause them on it's own. In order to produce an emotion this representation is then

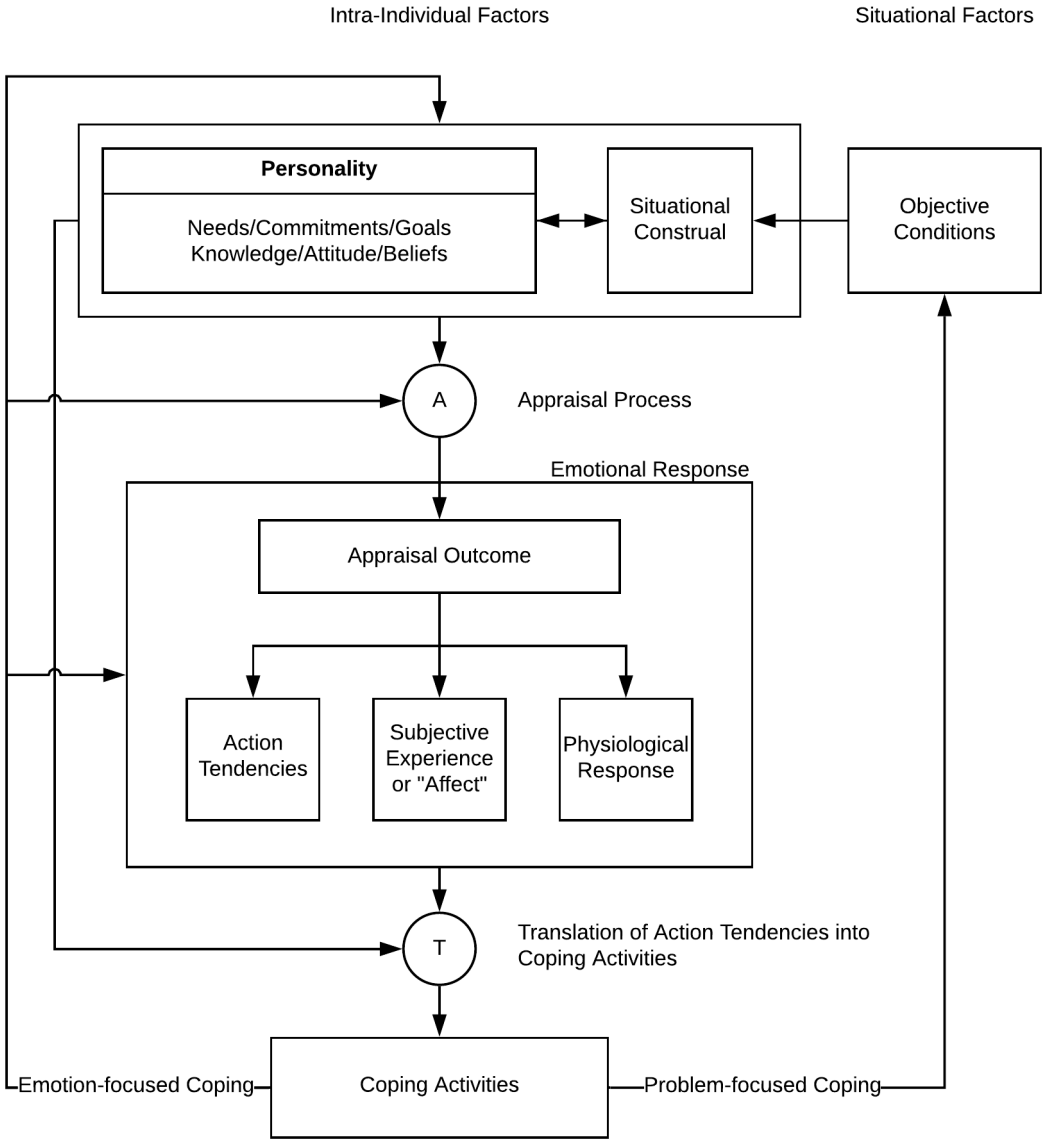

Figure 5.1: Model of the cognitive-motivational-emotive system [10]

appraised by the second type of cognition. In the appraisal process the representation is evaluated with regards to relevance for the individual's well-being which then directly determines the emotional state [10].

Appraisals themselves can be split into primary and secondary appraisals. Primary appraisals concern the encounters relevance to the individual's well-being and can be further split into *motivational relevance* and *motivational congruence*. *Motivational relevance* determines the encounters importance in regards to the individual's goals and concerns, while *motivational congruence* concerns how the encounter brings the individual closer or further away from their goals and to what extent [10].

Secondary appraisal can be split into *accountability*, *problem-focused coping potential*, *emotion-focused coping potential* and *future expectancy*. *Accountability* determines who deserves to be credited or blamed for an event and therefore provides direction to the emotional response and the related coping actions. *Problem-focused coping potential* relates to the evaluation of possible actions the individual could take in their current situation to get closer to their goals. *Emotion-focused coping potential* evaluates possible gains by adjusting of the current emotional response to the current environment and *future expectancy* concerns the possibility of emotional changes that would make the situation more or less desirable for the individual relative to their goals.

They further consider personality as an important part in the emotional response, since it has a strong influence on the appraisal process on two levels. For primary appraisal, motivational factors such as the values an individual holds dear, their goals, and their commitments are important. These are crucial, because the relation to the environment has to be with these personality factors in mind for the primary appraisal process to work. Without these personality components it could not be evaluated how an event affects the individual's goals [10].

For secondary appraisal personality factors such as beliefs and expectations play a role and are required for emotional differentiation. The beliefs influence the expected effectiveness of the actions the individual could possibly take and their confidence into their own ability to perform those actions successfully. They help in evaluating coping potentials and future expectancy. Knowledge and beliefs further contribute to primary appraisal, because they play a role in determining whether a situation might be beneficial or harmful, or to what degree it is relevant to the individual's goals [10].

The appraisal is influenced by personality factors and different variables in the environment. This is important, because if the emotion response was purely rooted in biology it would not be possible for different people to appraise the same environment in different ways, and the same person might not be able to appraise the same environment differently at a different time. The influence of personality traits and environment on appraisal is required, because without them an individual would not be able to judge whether the current situation has any impact on their subjective

well-being. Those factors are used in the appraisal process to generate an emotional response which is determined biologically. Another factor they contribute to personality is the person's knowledge regardless of their environment. It consists of their generalized beliefs about the nature of the world, how things work in that world, as well as their own place within it and further influences the appraisal process. Personality influences the emotion response on two levels. It affects the *situational construal*. This is the cognitive representation, or knowledge, an individual has about their current *person-environment relationship*, which is ultimately what is being appraised. Then, there are some personality factors that influence the appraisal process directly. These factors are the individual motivations, such as their goals and needs [10].

The emotion response includes an *action tendency*. Action tendencies determine how we would like to respond to an encounter, however, unless we are in a state of extreme emotional arousal, they can be cognitively suppressed. By doing so the individual can choose their response from a variety of coping options [10].

As a result of the emotion response an individual can engage in self-protecting coping mechanisms, which in turn change the appraisal. An appraisal of a situation can also change when the knowledge about the environment changes, the individual abandons or changes their goals and beliefs, or when when their social structures change [10].

The biologically innate part of their *cognitive-motivational-emotive system* is the emotion response itself. It takes over after an appraisal pattern with it's *core relational theme*, the meaning associated with an emotion, has been generated. The appraisal pattern leads to the generation of an emotion, which includes a a subjective feeling state, corresponding action tendencies and a motor-physiological response pattern [10].

The appraisals are responsible for detecting and evaluating whether a situation is relevant to an individual's motivations or not and if the situation requires them to adapt to or act upon it. The appraisal process results in an emotional state, which prepares the individual to react and deal with the current situation. The emotion response is then translated into a coping action. The coping action results from the emotion response, but is also influenced by the personality and cultural factors. These determine what the individual deems an acceptable action, based on their values and cultural background, for example. This component of the system and the appraisal process are where the biological and the socio-cognitive part of the system intersect. Both are required for a full emotional response [10].

Ortony, Clore and Collins

Another appraisal model was developed by Ortony, Clore and Collins, commonly referred to as the *OCC model* [11]. It was developed as the foundation for a computational model of emotion and as such has become quite popular among computer scientists.

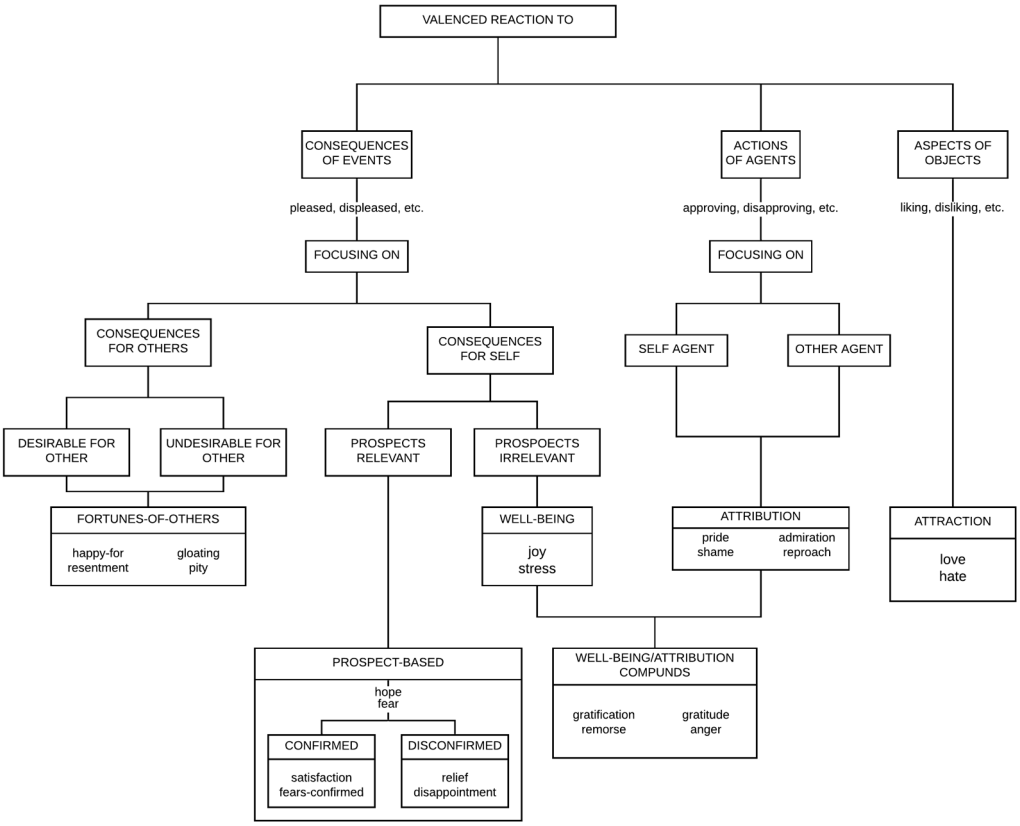

Figure 5.2: Global structure of emotion types [11]

They consider emotions as reactions to events, agents or objects. These reactions are valenced and vary depending on the context of the eliciting situation [11].

Similar to emotion families as proposed by Ekman [8], the *OCC model* defines emotions types, which they split into three classes of emotion. The model contains 22 individual emotions. The first class concerns reactions to consequences of events, in terms of pleasure vs displeasure. The second class contains reactions to actions of agents, with regard to approval vs disapproval. The third and final class is about emotions related to objects, in terms of liking vs disliking [11]. You can find a model of their emotion structure in figure 5.2.

In the *OCC model* the appraisal of a situation and the emotions it elicits is based upon three central variables, which are each uniquely associated with one of the classes of emotion. The variable concerning emotions based on events is *desirability*. *Desirability*

takes the goals of the subject into account. It reflects whether the situation interferes or works towards the goals and the subgoals of the subject. The model differentiates between active-pursuit goals, which the subject actively tries to obtain, interest goals, which are usually not pursued due to a lack of control over their realization, and replenishment goals which include the satisfaction of basic human needs such as hunger. *Praiseworthiness* concerns the actions of agents and how these actions relate to the standards of the subject. Standards are, for example, what the person thinks is right or wrong. The final central variable is *appealingness* and reflects the attitude the person has towards an object [11].

The intensity of different emotions is further affected by global variables, which affect all emotions, and local variables, which affect only specific groups of emotions within the different classes. The first global variable is the *sense of reality*. This relates to whether the situation that induces the emotional response appears as real to the subject or not. A situation does not need to be real, however, to elicit an emotion. Experiencing a dream or a fictional movie can still result in an emotional response, while someone who can't accept a situation might not have an emotional response although the situation is very much real. Then there is *proximity*. An emotional response tends to be of higher intensity if we are psychologically closer to it. Memories, for example, can still elicit the same emotion that we experienced in the situation, but it might no longer be as intense as it was when it happened. *Unexpectedness* takes into account to which degree the situation which the individual currently finds themselves in surprises them. The final global variable is *arousal*, It determines to what degree the individual is already aroused prior to the situation. Being already aroused from a previous situation can lead to a higher intensity emotion from the current situation, for example [11].

The local variables are only applicable to their corresponding emotion group. In the reactions-to-events class there are prospect-based emotions with the variables *likelihood*, the degree to which an individual believes that the anticipated event will actually happen, *effort*, the amount of resources that had to be used in order to avoid or secure the anticipated event, and *realization*, which refers to whether the anticipated event manifests in the end or not. Emotions from the fortune-of-others category are determined by how desirable the individual thinks the situation is for the goals of the other person (*desirability-for-other*), how much the individual likes the other person (*liking*), and whether they believe the other person deserves what has happened to them or not (*deservingness*). The attribution category in the reaction-to-agents class uses the central variable *praiseworthiness* to determine the intensity of emotions. The intensity is further influenced by the degree to which the individual can identify with the agent responsible for the situation (*strength of cognitive unit*) and the degree to which the actions of the agent deviate from the individuals standards (*expectation deviation*). In the

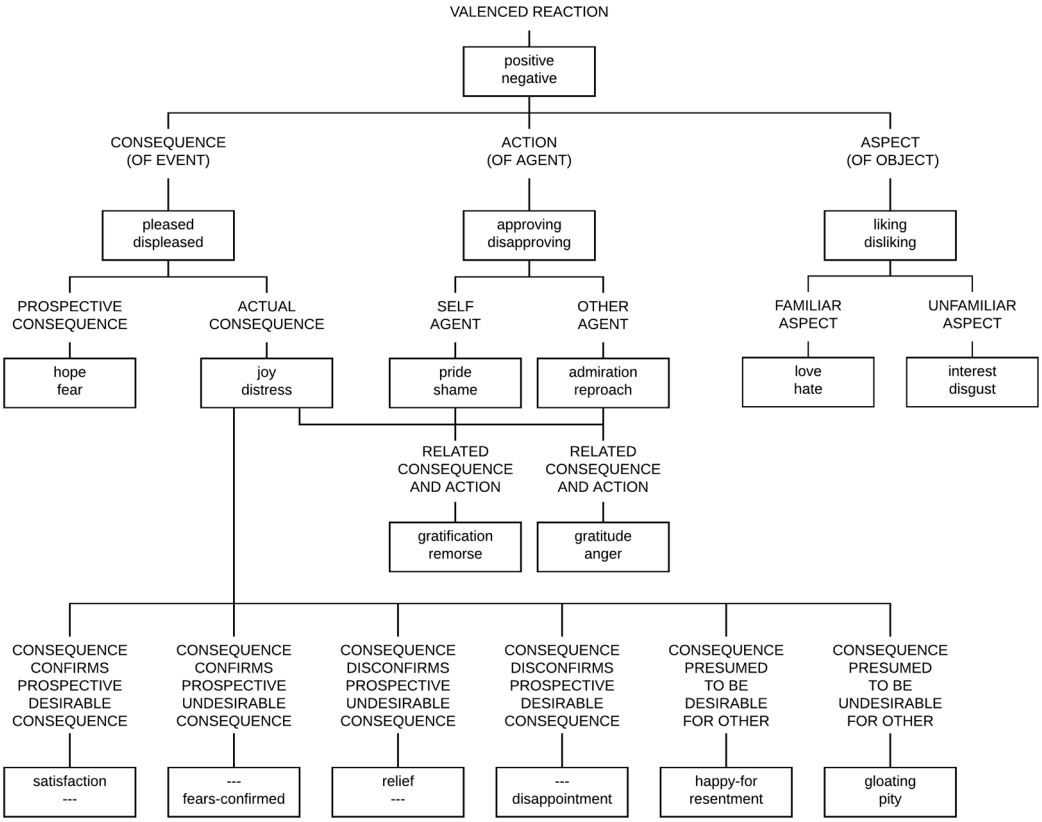

Figure 5.3: Disambiguated, inheritance-based hierarchy of emotions based on the *OCC Model* [45]

reaction-to-objects class there is the *attraction* category, which depends in addition to the central *appealingness* variable also on how familiar the individual is with the object [11].

It is possible for an emotion to arise in a situation without all of the global or corresponding local variable being specified. At least one of the central variables *desirability*, *praiseworthiness*, and *appealingness* needs to be specified, however, for any emotion, from their corresponding emotion class, to arise [11].

The *OCC model* has been further refined by computer scientists [45] in order to easier adapt the model into a computational framework. The original authors had left a variety of ambiguities in their model which made it problematic to realize the model according to their specifications. They have rearranged and further specified the hierarchy of the model. It now allows to distinguish between a very general and

unspecific notion of emotion like positive or negative and the specific emotions such as satisfaction. They strengthened the relation between emotion type specifications and the underlying logical structure and it is now easier to view the model as an inheritance diagram as can be seen in figure 5.3 [45].

5.3 Computational Models of Emotion

Although all of these theories of emotion explain how our emotion response works, they do so, for the most part, on a rather high-level from a psychological perspective. Computational models of emotion are frameworks that allow us to simulate an emotion response. They are based on one or more theories of emotion and need to resolve the ambiguities left by the authors of those theories. To simulate emotions every step of the emotion response needs to be explicit in order to be implemented. The models need to consider how emotions arise in us as well as how they evolve when an eliciting event changes. Both, the physical environment and social situations can cause emotions. When the dynamics of the environment or of the individual's physiology change then so do their emotions. Sometimes the emotional response is very quick as part of behavioral processes and sometimes they are the result of a cognitive process, taking a little more time before they occur [46]. Currently emotion theories of appraisal are most commonly used for computational models.

5.3.1 EMA

The *EMotion and Adaptation* (EMA) model [46] is based on the *cognitive-motivational-emotive system* [10]. The system starts with the appraisal of the situation based on the *agent-environment relationship*. This leads to an emotion response, followed by a coping RESPONSE. Coping then leads to a change in the agent's relationship with the environment. After that the system loops back to the beginning and the situation is appraised once more [46].

The model uses a representation of the *agent-environment relationship* as input and output of the appraisal processes. The representation contains a set of beliefs, desires, intentions and plans of the agent as well as utilities and probabilities [46].

The appraisal process itself is based on the assumption that appraisal happens fast, appraisals can happen in parallel. They are made automatically and happen continuously. The variables resulting from an appraisal are stored in the appraisal frame and are associated with their corresponding event. The variables include the perspective. An event is judged from the own as well as the perspective of other agents. The *relevance* of an event. An event is relevant if it has a non-zero utility for some agent. The *desirability*, a positive or negative value that represents whether the outcome of

an event would be desirable for the agent. The *likelihood* of the outcome of a event. *Expectedness*, the extend to which the current state could have been predicted from the causal interpretation. *Causal attribution* assigns credit or blame to another agent. *Controllability* of the event measures whether the agent could alter the outcome of an event by themselves and *changeability*, whether another agent is capable of changing the outcome [46].

Once an event is appraised an emotion type with some intensity is derived. Although, the appraisal is primarily responsible for the agent's emotion and coping responses the system uses a bias to account for mood. Mood is calculated by aggregating the individual appraisal frames that are kept for each event with their intensity. The average of different appraised events over time, disassociated from the event that elicited those frames initially, is kept as the mood variable. New appraisal frames are adjusted by this variable. The most recent frame with the highest intensity after mood adjustment determines the coping response by the agent [46].

The model features different types of affect consequences or coping actions. These determine how the agent responds to the appraised event. The purpose of this response is to change the agent's subjective interpretation of the *person-environment relationship*. *Attention-related coping* focuses the agent's attention to certain features of the environment. *Belief-related coping* changes the agent's belief states to change their current emotional state, e.g. shifting the responsibility for an action to another agent. *Desire-related coping* alters the goal priorities of the agent to change the emotional state into something more desirable. *Intention-related coping* results in taking an action or changing the agent's intentions to regulate the emotions. The system proposes different coping strategies in parallel. They are then ordered according to a set of preferences and executed in sequence. If an appraisal has a high control variable then problem-directed strategies like taking action or planning would be executed. With low control emotion-focused strategies, such as the agent distancing themselves, would be executed [46].

5.3.2 MAMID

The *MAMID* (Methodology for Analysis and Modeling of Individual Differences) model [7] is a cognitive-affective architecture. The purpose of the architecture is to generate emotions and calculate their effect on the behavior of agents.

At the beginning of the methodology lie individual differences. On a cognitive level each agent can differ in their speed and capacity for attention and working memory. Further, an individuals personality traits are considered. The traits used are extraversion, neuroticism, aggressiveness, and conscientiousness. This corresponds to the *three-factor model* with the addition of conscientiousness as proposed by the *OCEAN model* [40].

The traits influence the generation, intensity, duration and expression of affective states such as emotions or moods. The individual differences then determine the parameters used by the cognitive architecture. The parameters affect the architectures processing by determining capacity and speed of the different modules and can also add biases for some modules of the architecture. They also affect the architecture structure by influencing the content and structures of the long term memory. A neurotic and introverted agent, for example, will be more likely to experience intense anxiety or fear, this predisposes the agent towards threats and eventually adds threat biases to the attention, situation assessment and expectation generation modules [7].

MAMID's cognitive architecture is considered a sequential "see-think-do" architecture. The agent takes environmental cues as input. These cues are used in a seven step process which outputs an action for the agent to take. First the environmental cues are filtered by the *attention module*. Cues contain the states of other entities, the environment or the agent itself. The cues are ranked according to their relevance to the agent and then further processed in the *situation assessment module*, which maps the cues onto a higher level situation using belief nets. The *expectation generation module* follows, which projects the situation onto possible future states the event could result in [7].

In the next step the *affect appraiser* determines the change in the agent's emotional state. The appraisal process uses the environmental cues, the results of the situation assessment and the expectation generation, as well as the agent's goals to determine the new emotional state. The appraisal process outputs both a dimensional representation and a categorical representation of the emotion. The dimensional assessment represent the result of an automatic appraisal with universal elicitors taken from the enviromental cues. A positive or negative valence of a certain intensity (arousal) is generated. The categorical assessment represents an expanded appraisal with elicitors more specific to the individual agent, their goals for example. This allows different actors to have different emotional responses to the same situation. For each of the four basic emotions an individual intensity is calculated. The intensities of the four basic emotions and the valence are adjusted by the current emotional state of the agent and then passed on. After that the *goal manager* selects the currently most relevant goal and the *action selection module* selects an action that is most likely to achieve that goal. [7], [47]

MAMID was developed with a peace-keeping simulation to test it's capabilities. Hudlicka exemplifies the process by comparing it using one commander with high and one with normal anxiety levels. In the situation both commanders are confronted with a hostile large crowd. The anxious commander perceives the crowd as very dangerous and stops them with lethal crowd control methods as well as requesting help. The other commander perceives danger level from the crowd as low and stops them utilizing non-lethal crowd control [7].

6 An Emotion Engine and Model of Emotion for Video Games

6.1 The Emotion Model for Video Games

The computational models of emotion are all directed towards the simulation of emotion in virutal agents and the resulting behavior. An emotion model that is to be used for reinforcement of a story's emotional content should be able to target more components of a video game than only it's characters. However, considering that Aarseth suggests that the most narrative potential in video games could be gained from deeper characters and that characters play an important part in emergent storytelling it seems reasonable that any such system should be able to model the complex emotions required for deep and believable characters [16].

Based on this assumption the model should include an appraisal mechanism to determine the emotions experienced by the character [10], [46]. The emotional response should result in some form of coping mechanism by the character. The appraisal and the actions taken by the character should be influenced by the characters personality and mood. We want to use the emotion model to influence the emotional expression of the game and not only it's characters. Therefore, an agent in the context of the model can be a character, but could also be a component of the environment or the game's representation.

Emotion Representation

The representation of the actual emotion should occur from two perspectives similar to *MAMID* [7]. A dimensional representation, based on the circumplex model of affect by Russel, and a categorical representation, based on an appraisal model such as the *OCC model* [11]. During appraisal the categorical emotion is determined and labeled. A mapping is required to get the dimensional representation of an emotion. All of the emotions that are considered by the *OCC model* are either positive or negative, this allows us to get a valence value from the emotions. Many of them require additional context. 'Gloating', for example, only makes sense in the context of an event that is undesirable for another agent. That context might be lost in the dimensional

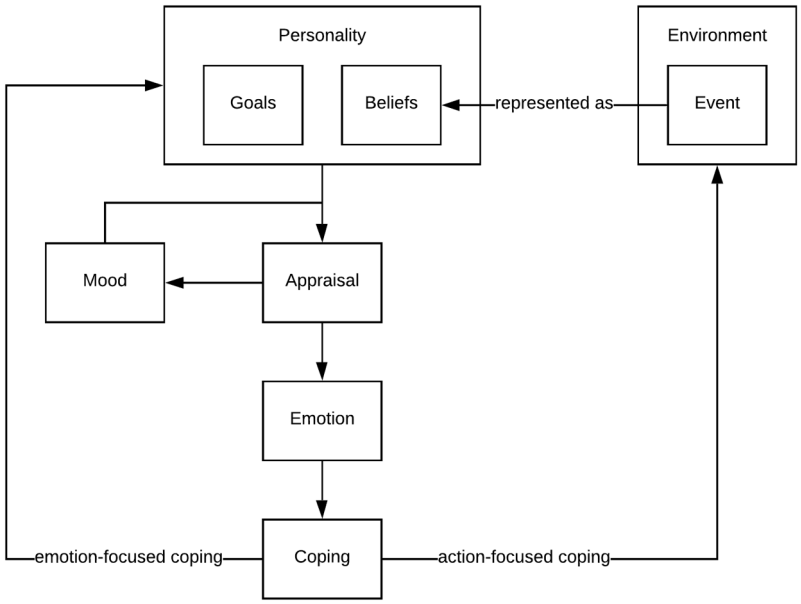

Figure 6.1: The Emotion Model

representation. This is probably not problematic, because we will use the dimensional representation only to determine the mood of an agent, which in turn determines whether an emotion is intense enough to lead to a coping action. The dimensional representation is sufficient for that. The dimensional representation also allows us to map a specific emotion into a less specific emotion by only looking at the valence dimension, for example, if that's all that's required for a component of the system. Since emotions only last for a brief duration they also need a decay function that returns an agent's emotional state back to neutral. The duration of an emotion should depend on its intensity.

Environment

The model needs to consider the game's environment. The *OCC model* [11] considers emotions as reactions to either actions of agents, consequences of events or aspects of objects. In the environment of a game we can find objects and agents. The agents, including the player, can interact with the environment. The interaction leads to events which occur in the environment. An event can have implications for an agents goals and are therefore relevant emotionally. We use those events as input for the appraisal

mechanism, which leads to an emotional response.

Personality

The personality in the model should consist of an agent's personal goals and knowledge they believe to have about the environment. As suggested in the *OCC model* [11], goals should be differentiated as active-pursuit goals, interest goals, and replenishment goals. Each goal should be annotated with an utility to enable the agent to prioritise the goals and the actions they take to accomplish those goals. The *GAMYGDALA* [3] engine, a black-box emotion engine that models emotions for NPCs after the *OCC model*, annotates events with beliefs. A belief uses several variables to model the environment. Likelihood as the degree to which the agent believes the information to be true. The belief attributes the event to the causal agent, who is seen as responsible for the event. Each belief also contains a list of goals which are affected by the event together with a congruence that measures whether the event facilitates or hinders a goal [3]. This belief-system should work as knowledge representation about the environment for our system as well. It should be expanded by another list of actions that could be taken in order to mitigate or further the event .

Mood

In addition to the personality an agent's mood should be considered. The mood should only use a dimensional representation using valence and intensity as suggested by Russel [12]. It influences the agent during the appraisal. The mood of an agent is determined by the average of the emotions that result from the appraisal process. Emotions should also be considered in the mood variable regardless of whether they are ultimately expressed or not. It would be unlikely for an agent in a positive mood to suddenly experience the emotion of anger, unless the eliciting event causes the intensity of the emotion to be high enough. Nonetheless, the agent's mood would probably take a hit and get closer to a neutral or even negative valence. The mood variable should prevent an agent to have sudden changes in emotion that might seem unrealistic and make them unbelievable. It should also prevent them from experiencing the same emotion with the same intensity all over again. A hungry agent, for example, might become very pleased once they eat, but due to the mood variable the intensity of any pleasure experienced from continued eating should reduce until eventually they might not derive any more pleasure from eating. The different emotions that make up the mood should decay from the variable over time, which in turn should result in a decay of the mood towards a neutral state as well. However, since moods have a higher longevity than emotions this should take longer than the decay of an emotion takes.

Appraisal

The appraisal mechanism is at the core of the model and responsible for the actual calculation of the emotional state. An event is evaluated with regard to the agent's goals, which are affected by the event. However, the event is not directly evaluated, but instead via an agent's beliefs, which represent their knowledge of the event. The variables in which terms the event is evaluated should be similar to those of *EMA* [46]. Namely, the *desirability* of the event, the *likelihood* of the event occurring, an *attribution* of the event to another agent if possible, and the *controllability* an agent has over the event. The authors of *GAMYGDALA* [3] suggest that an event's desirability is the product of the utility of the affected goal and the congruence that determines whether the event facilitates or hinders a goal. The likelihood and attribution of the event is contained within the belief already. We could determine the controllability by comparing the actions available to the agent with those that are believed to affect the event. The controllability is necessary to determine what action the agent should take.

Table 6.1: Eliciting Conditions for Emotions

Eliciting Condition	Emotion Label
desirability(self) > 0, likelihood < 1	Hope
desirability(self) > 0, likelihood = 1	Joy
desirability(self) > 0, attribution(other)	Gratitude
desirability(self) > 0, attribution(self), likelihood = 1	Gratification
desirability(self) < 0, likelihood < 1	Fear
desirability(self) < 0, likelihood = 1	Sadness
desirability(self) < 0, attribution(other)	Anger
desirability(self) < 0, attribution(self), likelihood = 1	Remorse

For each goal maintained by the agent the variables need to be determined. Based on the desirability, likelihood, and attribution the emotions that would be elicited by the event, for the individual goals, are determined. We can calculate the intensity of an emotion as the product of the likelihood and the desirability. We then need to convert the appraised emotions into their dimensional representation to adjust it by mood. For now, we will assume that the intensity and desirability of each emotion are directly translated into the arousal and the valence component, respectively, of the dimensional representation. This might be inaccurate from a psychological point of view, however. Once the different appraisals are adjusted by the mood variable. The emotion with the highest intensity after the adjustment should be chosen for expression. After that, the mood variable is adjusted by all of the emotions that resulted from the appraisal

regardless of whether they were expressed or not.

Coping

As result of the appraisal mechanism the character should engage in some kind of coping action to respond to the situation. If the agent has the ability to engage in an action that furthers or mitigates the goal they could choose the action they believe to have the highest chance of succeeding or the one with the highest potential impact on the event. Whether an agent is risk-averse or not could probably be determined through a character's personality traits. However, at this point the model does not consider the influence of personality traits on appraisal or coping. Whether agents prefer actions with high success chances or high potential impact would at this time be determined by a designer, either for all characters or for each individually. If an agent is unable to take an action that would mitigate or further the event, they could engage in emotion-focused coping. Here an agent could shift the utility of a goal or perhaps even outright drop it. For example, a soldier who has witnessed his entire company get slaughtered by the player might fear for his life. The soldier might doubt their ability to kill the player on their own and could then decide that dropping the goal 'kill player' would result in a less negative emotional response.

6.2 The Emotion Engine

The emotion engine allows different components of the game to respond to the events that happen during the course of the game in an emotionally coherent manner. It receives input from two actors in the from of events.

Player

The first actor who enters input into the system is the player. The player generates events when interacting with the game. The actions the player can take are determined by the mechanics. Not every action the player can take needs to necessarily generate an event. The emotional value of the player traveling through the environment might be questionable. If the player flees combat, however, 'traveling' would lead to an event with emotional value for the involved characters. If the game uses a branching or open narrative structure the player would also be able to make decisions regarding the course of the story through events.

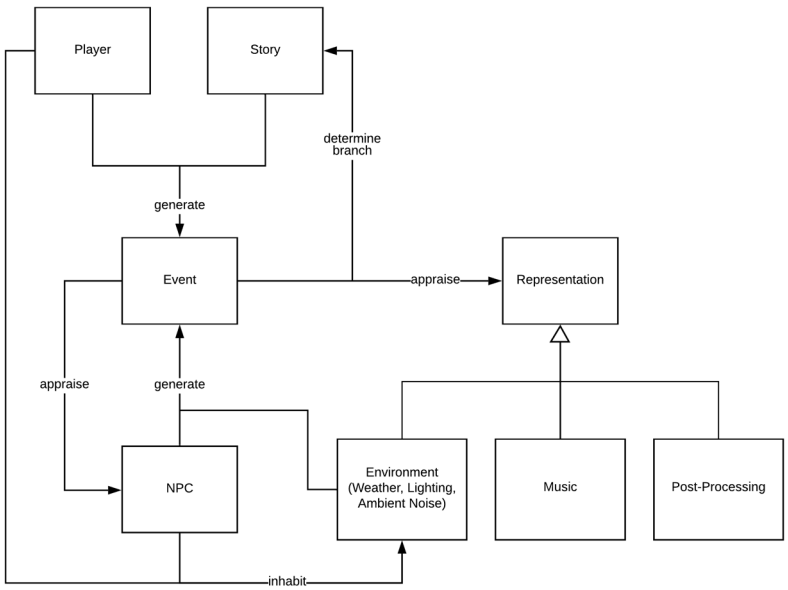

Figure 6.2: The Emotion Engine

Story

The second actor entering input is the story. While the player generates events through interaction, the story would need pre-authored events. The story events are also triggered by the player when they reach certain points in the game or make certain decisions. The story component allows for authorial control rather than hoping a coherent narrative with emotional impact will just emerge from the interaction between the player and the environment. In order to influence the emotional meaning of the narrative the story component can add and drop goals to and from the environmental actors.

Event

Events are at the core of the engine. They are generated by the player, the story, the NPC and the environment component. The NPC and the representational components appraise them to determine how to react and which emotions to display. Every event that should be emotionally relevant needs to be annotated with a belief for any actor who should react to the event. The result of actions taken by the player or a non-player character, decisions or dialogue options a player makes lead to an event. The story or

the environment can also trigger events when certain conditions are met.

Non-Player Characters

One component of the engine are NPCs. NPCs appraise events as we explored previously and generate an emotional response which leads to an action by the character. Through interaction with the environment NPCs are also capable of generating events, which they, again, appraise. The generation of events and the appraisal of them through characters could lead to interesting emergent stories. However, since we can not rely on emergent storytelling alone to tell an interesting narrative in the game, we still use an authored story component to guide the player. The player can derive the emotion of a character from their actions, which also includes feedback such as the character's stance, facial expression and possibly their ambient dialogue.

Representation

We require some sort of output to convey the emotional state of the game to the player. This mostly happens through the game's representational components. The player can perceive the emotions that result from the system in several ways. The representational components need to appraise events just as a character would. This allows the representation to react emotionally to the input given by the player or the story. To keep authorial control over what emotions are conveyed in the context of the story, the story component needs to set the goals of the representation and events generated by the story need to affect those goals. The representation components can then react to those emotions by changing their state to match the emotion.

For one, we have an output that represents emotions through environmental components. If a state of positive emotion turns negative during the story then we might want to have the environment to reflect that. The weather could turn from sunny to cloudy, to rainy until it eventually becomes a thunderstorm. The environmental components also include lighting and the ambient noise, which can be directly observed in the the environment, but there might be more components of the environment that convey emotional meaning which are not listed. The lighting and ambient noise intersect with two other components of the game's representation. The visuals and audio. These are important if we want to convey the emotional impact of the story or even just an event to the player. Music can evoke a wide range of emotions in us humans. Similar to *Scarlet Skellern and the Absent Urchins* [4] the music would need to be adaptive so components of the piece could be changed in order to convey the desired emotion that fits the current event or story beat.

Visually we could adapt the color of the image in a post-processing step to further

emphasize the emotions currently prevalent in the game. Research suggests that we perceive bright colors as more pleasant and less arousing than dark color. There also seems to be a weak connection between color saturation and arousal, where highly saturated colors lead to higher arousal [48]. By adjusting the saturation, brightness, and possibly hue of an image we can further convey the emotional meaning of the experience to the player [4].

Environment

The environment is part of the representation, but it also acts as the world space which is inhabited by all characters and in which all events take place. Some of it's components are used to represent the emotions conveyed by the game. When the environment reacts to an event it appraised it is possible that it generates new events. Characters should be able to react to weather or lighting conditions, or ambient noises they hear as these might have consequences for the goals of characters.

7 Outlook

In its current state the model would allow us to react emotionally coherent to an event across different components of the game. It can be used to tell an authored story and represent it's emotions through some of the game's systems. A next step could be to develop a prototype of the model and system and to evaluate whether it has any impact on players emotionally. Currently the model disregards any emotion related to objects as well as those related to agents independent from an event. Some of the emotions proposed in the *OCC model* [11], such as guilt or resentment, are considered social emotions, which require the context of a social relationship between two agents. The addition of social relationship component could allow for such emotions in characters as well. There might be less application of those emotion for the other components. The personality component of the model could also be further developed. The integration of personality traits as suggested by the *OCEAN* or the *three-factor* model [40], [41] might allow for more interesting and believable behavior by NPCs. Traits would affect the elicitation and intensity of emotional responses, as well as coping action. This could lead to an even greater variety between individual characters and give them a deeper personality, which might make the characters even more believable. It could also be beneficial to include some form of user modeling in the system to predict the player's current emotional state. Knowing the player's emotional state could allow the author of the experience to create an emotional arc that nudges the player towards the desired emotions.

8 Conclusion

The have explored some of the different components of video games and their relevance for a game's story. We have looked at the storytelling capabilities of video and the narrative devices they utilize to convey a narrative to the player. We have shown why emotions play an important role in video games as well as storytelling and why we could use them to improve the storytelling capabilities of video games. We explored the different perspectives on human emotions and how they can be modeled for a computational framework.

Ultimately, we laid the theoretical foundation for an emotion engine that could improve the quality of video game narratives through the use of emotion. Based on the assumption that video games are lacking in deep characters, we have argued that the incorporation of emotions in characters could lead to more interesting, realistic and believable characters. The engine uses an emotion model based on the appraisal theory of emotion and also incorporates core affect as a measure of mood that influences the emotion response. The emotion engine allows for emergent storytelling through an emotionally believable reaction by characters to events and authorial control over the story through the story component. It also allows to emphasize the emotional content of the story through the game's representational components, such as the environment or the game's music. In it's current form the emotion model used in the engine can only represent ten emotions. Especially in regards to social emotions it is lacking and could be further extended to model characters with personality and social relationships.

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