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A Procedurally Generated Approach to Emotional Storytelling for Games and Interactive Systems

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“I wanted stories, and I wanted them always, and I wanted the experience that only fiction could give me: I wanted to be inside them.”

Neil Gaiman

“Sometimes reality is too complex. Stories give it form.”

Jean Luc Godard

Abstract

One of the least noticeable applications in the area of Procedural Generated Content is in generating narratives. Furthermore, when it tends to be used, it focuses on plot generation. Unfortunately, this results in a disregard for the potential emotional impact that storytelling may bring to table, since that, in many cases, it is the way a narrative is told that results in some sort of emotional resonance for an audience. Through a study of storytelling techniques, together with an analysis of existing narrative-driven PCG systems, and by exploring various manners of emotional evaluation in art, a system was built that takes base narratives as input and, through an emotional model, adds storytelling mechanisms to them, seeking to differentiate and maximize one of two opposite emotional moods: Happy and Dour. These narratives are then played in the Virtual Tutor system. A series of experiments consisting of four different narratives were made to discern if the emotional valence of these was successfully differentiated and maximized.

Keywords

Affective Computing; Emotions; Storytelling; Narrative; Turn-taking.

Resumo

Umas das aplicações menos reconhecidas na área de Conteúdos Gerados Proceduralmente é a geração de narrativas. Para além disso, quando este género de aplicação é de facto usada, o foco encontra-se na geração de enredos. Infelizmente, isto resulta numa potencial negligência do impacto que *storytelling* pode trazer a uma narrativa, já que, em muitos casos, é a forma como a narrativa é contada que transmite as emoções mais fortes a uma audiência. Através dum estudo sobre técnicas de *storytelling*, juntamente com uma análise de sistemas CGP focados em narrativas e a exploração de métodos de avaliação emocional nas artes, foi construído um sistema que pega em narrativas base como *input* e, através dum modelo emocional, adiciona-lhes mecanismos de *storytelling*, visando diferenciar e maximizar um de dois tons emocionais opostos: Feliz e Sombrio. Estas narrativas são então corridas no sistema *Virtual Tutor*. Uma série de experiências construídas à volta de quatro narrativas diferentes foram desenvolvidas para discernir se de facto houve uma diferenciação e maximização de valencias emocionais.

Palavras Chave

Computação Afetiva; Emotions; Emoções; Narrativa; Tomada-de-turnos.

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Listings

Acronyms

PCG	Procedural Content Generation
DES	Differential Emotions Scale
HAC	Hevner's Adjective Circle
ICIDS	International Conference for Interactive Digital Storytelling
IPIP	International Personality Item Pool
NFA	Need For Affect
NA	Negative Affect
NLP	Natural Language Processing
NPCs	Non-Playable Characters
PA	Positive Affect
PC	Playable Character
POCL	Partial Order Causal Link
SAM	Self-Assessment Manikin
TEV	Total Emotional Value
VR	Virtual Reality
VT	Virtual Tutor

1

Introduction

Contents

1.1 Motivation

Ever since the early 1980's, the use of Procedural Content Generation (PCG) has been steadily increasing and evolving, with the gaming industry being its main user. As Shaker, Togelius and Nelson mention in the beginning of their book [1], from a game design perspective, a PCG system can be described as some software that creates game content automatically, or with assisted input from one or more game designers or players. One example of the former is a system that automatically generates a dungeon level for a role-playing game, while an usual example of the latter is a tool with an implemented AI that will help the level designer construct that same dungeon level. Two former course colleagues of mine, Lucas and Delgado, individually worked and developed such tools for their master's theses [2, 3]. Some of the earlier implementations of PCG come from games like *Rogue*[1], where levels were automatically generated with the assemblage of ASCII characters, while a recent game like *No Man's Sky*[2] uses a selection of deterministic algorithms to create a virtually infinite number of varied planets for players to discover. So it can be said that, throughout the years, PCG has been mainly used as an effective form of assisting game designers in the development of their games, by removing or simplifying time-consuming tasks, something that allows the developers to focus on the more creative and gratifying ones.

An area in game design where PCG is less knowingly used is in story generation, and that is mostly because it usually is subservient to other forms of procedural generated content. One of the main issues that arises from the procedural generation of (for example) a level for a game, is that it may seem thematically hollow for the player, with the game designer being unable to manually write it into the larger context of the narrative (if there even is one). So, as Shaker et al. mention in chapter 7 of their book [4], the generation of a narrative in conjunction with the level, will help bring more narrative meaning to it in the context of the game, resulting in a more satisfyingly emotional experience.

But how about the generation of narratives, not as a sort of support for other systems and mechanics in games and interactive systems, but as a crucial main component? One of the most important milestones towards this objective is the highly influential interactive storyteller *Façade* [5], where the user types the dialogue for his character directly into the game and important events in the narrative are triggered by them. From a game design standpoint, it was considered very limited, but, at that time, it was the most successful attempt at creating a truly interactive narrative where relevant interactions directly emerge from the player's actions, with a truly varied array of narrative outcomes. It is in these sorts of systems, the ones that take a narrative into account as a main and essential component, that the work detailed in this document revolves around.

[1] M. Toy and K. Arnold. (1980) Rogue: Exploring the dungeons of doom. Epix.
[2] H. Games. (2016) No Man's sky. Hello Games.

1.2 Problem

The main aspect that is usually focused on the current PCG narrative systems is the generation of *plot*, that is, the sequential events within a certain narrative domain that are originated through some combination of character related decisions. If we ignore the causal effect that goes into the character's decisions and events, we get a *story*, meaning that its a more simplified version of a proper *plot*, with a focus on "what happened" instead of "why it happened". The reason plot is the major target of this area is that, according to Reidl and Young [6], it is essential that a generated plot features a logical causal progression and believable character motivations. Due to this however, *storytelling*, the way the narrative is in fact told and expressed towards the user of the system, may end up being, for the most part, just a straightforward and direct recounting of events. By fusing both plot and an approach to storytelling (simple text, voice-over, cutscene, etc.), a *narrative* is obtained. Now, while making logical and sequential sense as intended, the narrative may still end up being an unengaging experience for the player. This will most likely derive from its simplistic storytelling approach. As a consequence of the many intricacies one has differently from another, not every narrative is supposed to be told in the same way, otherwise potential emotional resonance may be concealed from its audience, leading to a frustrating narrative experience.

Stripping back this issue to its core aspects, the main question that arises is the following: **how can we develop a system that, regarding a given plot, uses mechanisms of storytelling to maximize a certain emotional spectrum within it?** Because of this, the following aspects must be properly established: how the plot is defined when inserted into the system, how the storytelling aspect that results from that same plot is generated and represented, and in what manner will the emotional output of the entire narrative be evaluated, both on the system and the player. That will be specified further into this document.

1.3 Hypothesis

With this work, I aim to create a narrative manipulation model that generates the best possible version of a given narrative according to a binary emotional spectrum or mood (Happy or Dour). In this solution, the algorithm receives the plot for the narrative, and the user will choose one of two aforementioned emotional tones that will inform the chosen storytelling approach, resulting then in a version of the narrative where the storytelling fits it into that emotional "mold", This process is informed by an internal model that infers and estimates the emotional progression of the narrative in light of the two possible moods, and then certain sections of the narrative are omitted in order to allow a clearer perception of the desired mood.

The system which my solution will extend and operate from is a product from the work of fellow

students from Instituto Superior Técnico, Ricardo Rodrigues, Ricardo Pereira and Ricardo Silva. It is an interactive application for simulated tutoring for education purposes called *Virtual Tutor*, which in this work was repurposed as virtual storytelling system, where two virtual characters (Maria and João) relay narrative to the user and visibly emote according to its events. The developed system will also take advantage of the potential emotional effectiveness that a well-thought-out approach to alternating between narrators presents.

With all of this, the hope is that a **more intense and emotional** experience can result from the narrative and be **rightfully perceived** by the user.

1.4 Contribution

The major contributions this work hopes to bring are the following:

- Create an emotional model by which narratives can be evaluated in terms of potential emotional impact.
- Development of a system that uses this emotional model to reconfigure the perception of mood in a narrative by omitting specific sections of it;
- Ascertain the emotional impact that may derive from the right approach in regards to alternating between multiple storytellers while these are relaying a narrative to an audience;
- The importance of having storytelling as a main focus in procedurally generated narratives, alongside plot and characters, by showing that the right storytelling approach to a given narrative may result in more palpable and intensely felt emotions;
- Taking into account the current state-of-art regarding emotional storytelling in interactive systems.

1.5 Outline of the Document

In the following section of this document, I will be elaborating on some of the aspects regarding narratives, procedurally generated experiences, emotional models and evaluation of emotions arisen from art that will be relevant for the construction of my desired storytelling approaches. Following that, I will be detailing the implementation of my proposed model, along with the testing procedures, their results, conclusions and aspects that may be improved in future works

2

Related Work

Contents

In this chapter, I will be introducing and detailing a set of concepts and works that helped bring my project to life.

2.1 Building Blocks of a Narrative

In spite of having already given a brief description on the concepts of plot, storytelling and narrative in Chapter 1, there's a need to give each a properly detailed rundown and to explicitly distinguish them from one another, along with a proper definition of what exactly is a story, word sometimes used as a direct synonym to all of the other mentioned above. What I will do here is assemble a simple pyramid representation for what constitutes a narrative (see Figure 2.1). I will also relate these concepts to how the British novelist E.M. Forster described them in his book from 1927, *Aspects of the Novel* [7], many of which have remained relevant to this day.

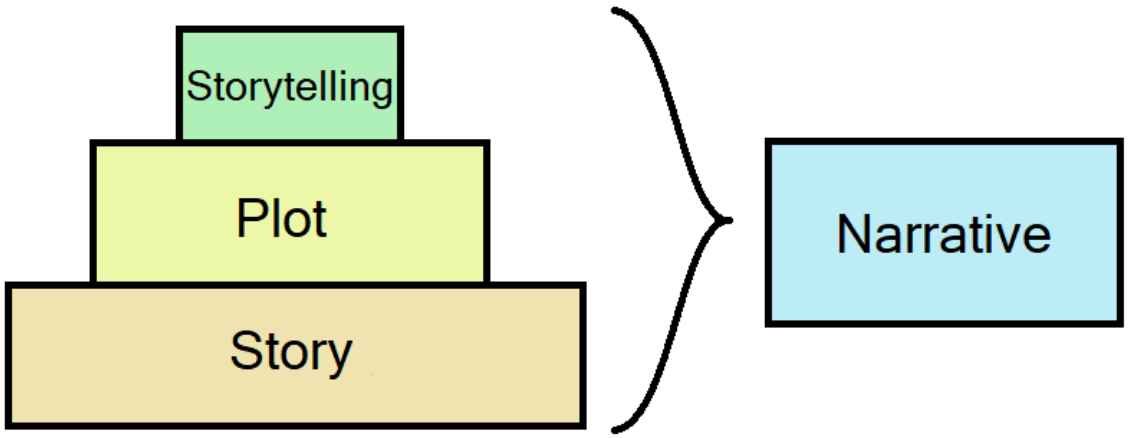

Figure 2.1: The narrative pyramid

Starting from the most basic concept, a *story* is the properly ordered timeline of relevant events inserted in a narrative. Forster described that, for the reader, the process of reading a simple story is based on the constant asking of "and then **what** happened?" The story is the foundation of any narrative, as it dictates everything that happens within it. This constitutes the base level of the narrative pyramid.

For its second level, we have the *plot* of the narrative, which takes the foundation lain by the story and adds a sense of causality to it. Meaning, it details the reasons and consequences for why the major events of the story happened in the first place. Forster describes that, for a plot, the reader finds him/herself in a continuous cycle of asking "**how** and **why** did that happen?" Due to this added level of depth, numerous different plots may originate from a single story.

The topmost level of the pyramid, *storytelling*, is the chosen manner in the plot is relayed to the audience. Forster's focus in his book is not on storytelling but, by applying the same sort of logic the

author used to summarize story and plot, storytelling can be viewed as the answer to "how am I told this?", for each of the successive plot points. This concept has been getting further attention as more visual and interactive forms of art have risen with the recent technological surge, such as cinema and video games. With these three ideas combined, a proper *narrative* is defined.

A descriptive scenario can be useful to exemplify these concepts. **"The knight fought the dragon. The knight was injured."**, is what was previously described as a story. It describes what happened in simple and direct statements, with the only relevant detail encompassing it being that it is a chronologically ordered description of events. On the other hand, **"The knight fought the dragon because he wanted to save the princess. The knight was injured because he was burned by the dragon's fire breath."** is a basic outline of a plot, seeing that it not only does it describe what happens in order, but also explicitly details the reasoning and consequences behind each event. Sadly, a concrete, foolproof example of storytelling is more complicated to conceive, and that is due to the various techniques writers and storytellers can use to tell and embellish their underlying plots. I'll describe a few relevant ones and try to relate them with the scenario chosen above.

- ***In Media Res*** - A very commonly used way to break away from traditional linear storytelling, where the narrative actually begins from an intermediate point of its timeline and not from the beginning, as is typically the norm. It serves as a way to instantly generate tension and interest in the audience, due to the immediate higher stakes and lack of a clear contextual foothold. This is very famously used in cinema, with Martin Scorsese's *Goodfellas* (1990) cold open as a prime example, or in the introductory chapter of the game *Uncharted 2: Among Thieves* (2009)[1]. Applied to the aforementioned examples, if **the narrative started after the knight was injured, without giving any other sort of context**, the audience would very likely be enticed to know what sequence of events led him to such a painful state.

- **Foreshadowing** - This a technique that is commonly used for having a plot-twist make sense in the larger context of its narrative, otherwise it may result in the audience's immersion being broken. The narrative must have some sort of clues for the twist sprinkled throughout its course. Again with the previous knight vs. dragon scenario, if in a certain section the narrative **a book with notes on how to convert a human into dragon using magic** appears, an eventual **"the dragon is the princess"** surprise reveal will feel narratively justified, and not just a simple gimmick to generate shock. Furthermore, if done with intents to establish sense of growing narrative tension, foreshadowing may as well be used to build up the viewer's anticipation towards some future story occurrence. As Bae and Young state, foreshadowing, as "hints of "what is to come"" [8]. Films like *The Sixth Sense* (1999) and *Fight Club* (1999) are main examples of how an effective use

[1] Naugthy Dog (2009), Uncharted 2: Among Thieves. Sony Computer Entertainment.

of foreshadowing validates their main plot-twists, while a film like *Se7en* (1995) uses it to create tension for its surprise ending. *Bioshock*[2] is a game where the latter is also the case.

- **Narrative Juxtaposition** - Essentially, it consists in establishing a sort of emotional or situational parallelism between two aspects of the same type that are present in context of the narrative. These can be tone, character personalities or themes. With this, one can create narrative contrasts or intensify one sort of idea or emotion. If in the **moment of the fight with the dragon, there is a sequence of flashbacks where the princess's suffering is seen while she is being turned into the gigantic monster**, the audience will more easily feel the desperation of the situation. The ending for *Inception* (2010) uses this technique to shuffle between three parallel sections of the narrative, which results in a growing sense of tension in the audience. The infamous "microwave corridor" sequence in *Metal Gear Solid 4: Guns of the Patriots*[3] also shows a multitude of stories happening at the same time, all with a desperate and tense tone that complement one another.

These are elaborate storytelling techniques writers can use, but there is a very wide range of elements that can be considered "storytelling techniques". In cinema for example, just the simple decision of filming a scene with a close-up instead of a mid or wide-shot is a relevant decision to the storytelling approach a film takes. But these more formal techniques referenced above are the ones that most informed the development of this project, albeit if in an indirect manner.

2.2 The Narrator

As Hühn and Sommer mention in their book [9], narration is "a communicative act in which a chain of happenings is meaningfully structured and transmitted in a particular medium and from a particular point of view". So it can be concluded that the type of narrator in a literary work is also a relevant choice in regards of storytelling.

There are different types of narration all throughout fiction, and each brings a unique point of view and approach to literary storytelling. Following, the two main types of narration are summarily described (from a literary perspective):

- **First-Person:** The narrative is told directly from the perspective of a character inside the story. In literature, it is an effective tool for the writer to blur the lines between the character and reader [10], resulting in a larger emotional connection between them. Famously used in works of literary authors such as H.P. Lovecraft or Haruki Murakami.

[2] Irrational Games (2007), Bioshock. 2K Games.
[3] Kojima Productions (2008), Metal Gear Solid 4: Guns of the Patriots. Konami.

- **Third-Person:** Type of narration where all characters are referred to by third person pronouns (he, she, they). It is the most common form of narration in literature. This type of narration can be *subjective*, which focuses on the characters feelings and ideas, or *objective*, which prefers to simply relate the facts of the story. The narrator can also be *omniscient*, knowing everything about every character at any given time, or *limited*, focusing on a very limited group of characters.

There are more aspects regarding narration that could be mentioned, but these are beyond the scope of the this work. Even still, the two ideas above felt relevant enough to be mentioned in this document. If you wish to find some more detailed information on this subject, see Hühn and Sommer's work [9].

2.3 Interactive Stories

Nowadays, more and more focus is being given to development of systems that properly allow users to experience interactive narratives, which are normally called **Interactive Stories**/**Dramas**. These types of narratives tend to differentiate themselves from other more traditional types by having an explicit focus in presenting a multitude of possible ways in which they may develop, branch out and conclude themselves. However, one should make a distinction between these types of systems and works categorized as Interactive Fiction. This is due to the noticeable different levels of technical depth both have, with Interactive Stories requiring a noticeable amount of work with AI and/or other complex systems, where an usable Interactive Fiction can be achieved by informal and straightforward programming and design.

As Crawford points out in [11], this area of research is unlike most in computer science. The study of Interactive Storytelling crosses over into other, more humanistic, areas, such as linguistic studies and psychology (as evidenced by in Section 2.5).

According to the description provided by Bostan and Marsh [12], these Interactive Story systems are typically made up of three different core components: The Drama Manager, the User Model and the Agent Model. A brief description of the three follows:

- **Drama Manager** - One could allude this component to the "writer" of a story. It generates new stories for the characters and user, while also executing existing ones. This manager must ensure that the overall narrative structure is properly organized and sequenced, having the capability of refining existing story beats if needed.

- **User Model** - It keeps track and logs the input actions from the user. By working in tandem with the Drama Manager, the system should adapt to its current user by reacting in an adaptive manner, which may result in a more pleasant experience for the user. To obtain favorable results, the developers must build an underlying player modelling system that is appropriate for the intended results.

- **Agent Model** - This component's objective is to manage the behavior of the Non-Playable Characters (NPCs) in the narrative system. It gives them objectives and motivations, which must influence their autonomous actions.

In the following subsections, I describe three of the main Interactive Stories of the past 15 years.

2.3.1 Façade

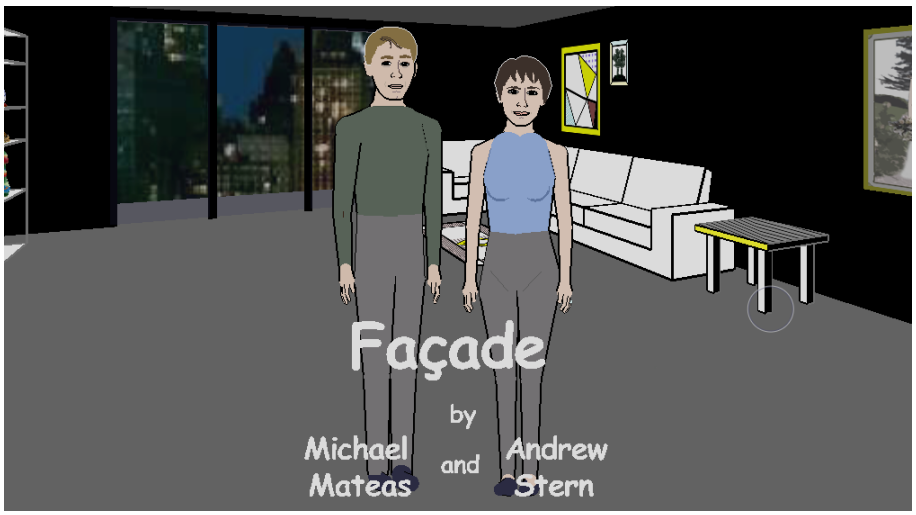

Figure 2.2: Opening Screen of Façade (2005)

The already mentioned *Façade*, released in 2007, is one of the most successful and influential Interactive Storytellers. It tells the story of a couple - Trip and Grace - who invite a friend of theirs - the player - to dinner at their home. Unknowingly to the main character, and by consequence to the player, the relationship between the two NPCs is rapidly deteriorating and by talking and interacting with them (or by doing nothing), the player can stop them from breaking up, inflict further harm into their relationship, or even be kicked out of their apartment, which results in an instant Game-Over. The element that made this Storyteller stand-out when it was released, was its innovative implementation AI modules that responded to written commands from the user, after these were analyzed by an internal Natural Language Processing (NLP) system. But as is common in the area of NLP, the proper interpretation of words by these kinds of systems is very likely to fail, which is mostly due to various types of language ambiguity [11]. Due to this, Façade is famous for its unpredictable understanding of the written inputs of the player, often resulting in confusing events, which lead to a loss of immersion on the part of the player. But as a technical object, *Façade* is a landmark in the area of Procedural-Generated Narratives, and how it slowly peels the existing conflict between the characters through the player's own input, marks an impactful use of effective user-focused storytelling.

2.3.2 Prom Week

In 2012, a group of researchers from the the University of California, in Santa Cruz, released *Prom Week* [13], a social simulator that, by featuring a design approach focused on theories of social interaction, could generate highly reactive narrative possibilities to its players. The biggest selling point for this system is its AI system, called *Comme Il Faut 2*, which was developed by the same researching team in 2010 [14]. As described by McCoy et al. [15], the system has a social state represented by six different components (Relationships, Social Networks, Statuses, Traits, Social Fact Database and Cultural Knowledge Base). The *CiF* algorithm then seeks to determine new "social games" for the characters to play, which will systematically alter the general social state for the entire playable cast. One example that is pointed out in the previously cited article is one where a "nerdy" type male character tries to flirt with a popular female character, which leads to her refusing him on accounts of him "not being cool enough". Because of a limited but well defined set of input actions, the player may originate a varied number of possible narratives, making it an highly replayable experience. The final system was very well received the community, with praise coming from several game critics and it ended up as a finalist for the 2012 Independent Games Festival and the 2012 IndieCade festival.

Figure 2.3: Prom Week (2012)

2.3.3 Bad News

From the aforementioned interactive narratives, one can infer that their focus lies specifically on the bottom and mid levels of the narrative pyramid defined in Figure 2.1. There's a clear focus on having the Drama Manager ordering the story beats in a logical manner, with the Agent Model adding sense of

reasoning to the on-going actions taken by NPCs.

Figure 2.4: Bad News (2016)

Taking this in to count, there is one unusual example of an interactive storyteller, which is the experimental game *Bad News* [16]. It interweaves a procedurally generated town with an accordingly unique background history, where the player must inform a certain character that a relative of theirs has passed away. The uniqueness of this game comes from the fact that the various non-playable characters the player can interact with are, in fact, played by a real actor sitting in front of the player. In a more detailed manner, the creators used an AI algorithm, called *Talk of the Town* [17], that creates characters and locations with complex and detailed mental models, which would have personal interests and conflicts that could lead them to lie, tell secretive information, or even forget some piece of relevant and useful direction, all of this in interactions with the player or amongst a sub-population of dozens of characters. The manager for each playthrough is a human Game Wizard, whose function is to receive vocal commands from the player and update the virtual environment. The Wizard also communicates relevant information to the player through a chat window. The entire cast of characters is played by a single professional actor, who needs to work the conversations towards relevant information for the main narrative. Albeit being a sort of experience where there is a more physical type of interaction, the results and feedback obtained by its developers reinforced that the combination of a realistic background and characters, in combination with the live-action interactive drama, produced a immersive and emotional experience for its players [18]. This focus in using a real-life actor as a stand-in for each NPC was a major decision from the developers towards impactful storytelling, which managed to bring a sense of realness that the player could find tangible. The major downside to this, is that it can only be played at select exhibitions and with specific, specialized actors. It is true that no properly defined random storylines are generated from this algorithm, but each of the players may gather a considerable amount emergent narrative meaning from the virtual lives of the NPCs, and with an effective technique towards empathetic storytelling.

2.4 Models for Procedurally Generated Storytelling

In the following subsections, I will be detailing the two computer models that inspired my work for this project, since both of them introduce storytelling techniques to augment the likelihood of emotional arousal on the audience of a certain narrative. Both are based in a family of algorithms called Partial Order Causal Link (POCL) planners. As described by Riedl and Young [19], "POCL planners represent operators in a plan as STRIPS (...) consisting of the operator name, a precondition – the conditions that must be true in a world for an operator to be executable – and an effect – the conditions in the world that are changed once an operator finishes execution", with the preconditions and effects consisting of a set of 0 or more first-order literals. As a formal definition, Riedl and Young define a POCL plan as follows:

> - A **POCL plan** is a tuple $\langle S, B, O, L \rangle$ such that *S* is a set of plan steps, *B* is a set of binding constraints on the parameters of the steps in *S*, O is a set of temporal orderings of the form $s_1 < s_2$ where $s_1, s_2 \in S$ and L is a set of causal links of the form $\langle s_1, p, q, s_2 \rangle$ where $s_1, s_2 \in S$ where *p* is an effect of s_1 and *q* is a precondition of s_2 and *p* unifies with *q*.

The advantage of using POCL planners is the procedural generation of plans for content is that they are capable of iterating over and fixing plans with flaws. According with Bae and Young [20], a flaw can be "an open precondition (i.e., no actions to achieve this precondition in the plan), a threat (i.e., a step whose effect conflicts with a causal link in the plan), or an abstract step which can be decomposed further".

However, I must point out that, despite referring these types of algorithms, my project was done without resorting to them. The reason for this is that a more simple approach was considered to be enough for the context of this work. Still, these following models still proved to be useful in a conceptual manner, so they remain fully relevant and warrant thus a detailed explanation, which is provided below.

2.4.1 Suspenser

Cheong and Young's *Suspenser* system [21] seeks to develop narratives that are specifically built to arouse suspense on the reader, through a combination of a planning algorithm with psychological theories about human mental cognition. By selecting which story elements are presented, the imaginary state and outcome of the story in the mind of the reader will be altered, resulting on feelings of "excitement or anxiety".

Some relevant theoretical concepts that are established in Cheong and Young's work are *fabula*, *sjuzhet* and discourse. These concepts are redefinitions of some of the ideas present in subsection 2.1 and are defined as follows:

- **Fabula:** The world in which the story happens, together with all of the characters, their actions and surrounding events. Relating it to how narrative is constructed earlier in this document, *fabula* can be described as the plot of a narrative.
- **Sjuzhet:** It is constructed from a subset of events in a *fabula*, which are then exposed to the reader in a certain order and form. Evidently, this is what I previously declared as being the concept of storytelling.
- **Discourse:** The chosen medium through which the narrative is presented to a certain audience. This can be film, a form of text or a video game.

Suspenser is described as a generator of potential *sjuzhets* for a given instance of a *fabula*, thus constituting the second third of a three part system for generating narratives. For input, Suspenser receives a previously declared *fabula*, a point in story time *t* and a desired story length, with which the system "determines the *sjuzhet*, the content of the discourse to be used to convey the story up to *t* to a reader, which enables the reader to infer a minimum number of complete plans for the protagonists goal". The aforementioned *fabula* (or plot) is constructed using a tool called Crossbow - described as a "hierarchical, planner based on the Longbow planning system [22]" - to create plans with a set of constraints and links that make sure the plot will end up being solid, both chronologically and causally.

The Suspenser process follows two major steps:

1. First, the system determines the skeleton of the received *fabula*, which are the core steps in the plan that are absolutely essential to the integrity of the story. A candidate skeleton is selected by measuring each of the events in the plan for important actions. This means that an event with a significant amount of receiving causal links, or a significant amount of sending causal links is likely important to the narrative's overall understandability. For example, "the first action in a story plan and actions that establish the goal state are highly eligible for inclusion in the skeleton", as Cheong and Young point out. After having a skeleton candidate, a two-phase algorithm is used to determine if it is understandable for the reader. The first step uses a reader model to check if the skeleton correctly specifies the goals for the protagonist of the story, by comparing it with a set of existing plans. If a match is found, the skeleton is deemed acceptable. Otherwise, the second step adds one of the most highly rated of the discarded events to the skeleton, and step one is run again. This is repeated until the skeleton is accepted.
2. After an acceptable skeleton is selected, the system tries to find possible actions that may oppose the main goals of the story's protagonist, and evaluates if they are likely to help build a sense of suspense on the reader. This evaluation is specifically done at *t*, the point where the building of suspense is supposed to happen. Then, the action with greatest potential of suspense is selected

from the ones not added to the skeleton. If the total potential suspense of *sjuzhet* is inferior to a certain, previously defined threshold, then the action is discarded. Otherwise, the action substitutes the one with the least potential suspense in the *sjuzhet* model. This is repeated until no potential candidate is found. Afterwards, the final combination of *fabula* and *sjuzhet* is sent as the Suspenser's output.

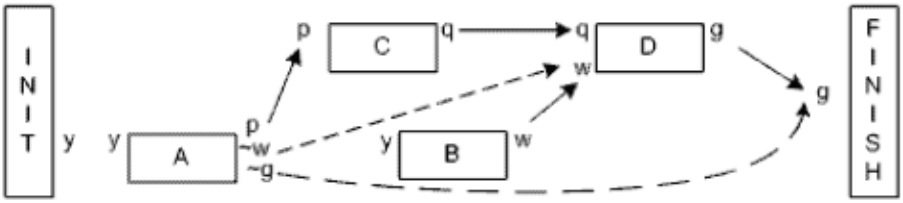

Figure 2.5: Visual representation of a plan in Suspenser. The boxed in, upper-cased letters represent actions, while the lower-cased ones are used to both represent preconditions and effects of actions.

The way the potential suspense for an action is measured, is by counting how its effects work against the objectives set for the main protagonist, together with the notion that the audience only knows parts of what is happening. As Cheong and Young exemplify through Figure 2.5, an effect of action A opposes the effect of action D (g vs. $\sim$g), and also goes against one of the effects of action B (w vs. $\sim$w). This results in total potential suspense of 2.

The major takeaway from this model is the manner in which its creators actively seek the idea of modelling and using narrative opposition in order to create a specific type of arousal on an user. The idea of narrative contrast (and subsequently, harmony) are integral to my work, along with the idea of using the possibility of developing a modular, sectioned narrative, with sections that may be removed without impacting the integrity of the central tale.

2.4.2 Prevoyant

In 2008, Bae and Young created a model called Prevoyant [20] that introduced two storytelling elements to a base plot: Flashbacks and foreshadowing (one of the few mentioned in Section 2.1). The main motivation for this work was that "emotions such as suspense, curiosity, and surprise help the readers focus attention on a story, contributing to the readers' sense of satisfaction". Essentially, they used these two storytelling techniques to instill a greater sense of surprise on the narrative's audience, resulting then in more enjoyable and memorable narrative experiences. As it is mentioned in the referenced article, "authors can let the readers know about some facts in advance or hide some information until a certain point for a dramatic effect". The model was based on two pre-existing story generators, which are Minstrel [23] and Suspenser [21] (the model detailed in Subsection 2.4.1), and combined the ideas of both to generate a broader array of more dynamic and engaging narratives. Minstrel is a "story

generation system" that introduces elements that foreshadow future storybeats, adding a growing sense of "inevitability" in the overall narrative.

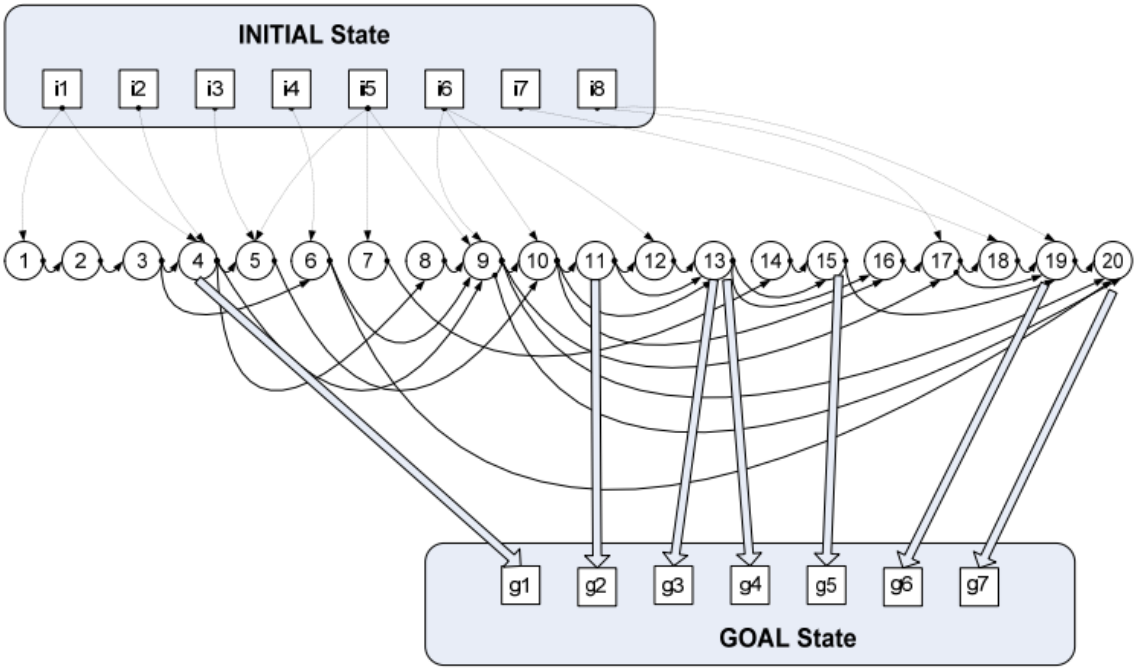

Figure 2.6: Relationships between Plan Steps (circles in the middle), Initial Literals (top-most squares) and Goal State Literals (bottom squares) in a *fabula* for the Prevoyant model.
Arrow connections detail what steps/states follow the current one. The idea is that all goal states must be reached, even when steps are removed or reordered.

Again, as an extension of the Suspenser system, the concepts of *fabula* and *sjuzhet* are carried over into Prevoyant.

Firstly, a *fabula* is needed as input for the model. Bae and Young use the *fabulas* generated by the already mentioned Crossbow tool, each of these being comprised of a set of ground literals that represent the backstory for the narrative, and a narrative consisting of a series of sentences taken from an ordered list of sentences that constitute the complete, unabridged narrative. A representation of this *fabula* can be seen in Figure 2.6.

Following that, Prevoyant's own internal Reader Model takes the Longbow's plot plan and refines it. It fixes flaws in the plan (preconditions that are unfulfilled, or contradicting steps, for example) preventing the reaching of the goal state, while making sure that, regarding to narrative, the reader can infer on the foreshadowed information, and comprehend the context of a flashback. The way the viewer model does this is through an internal heuristic function.

Next, the Prevoyant's system uses a "generate-and-test" approach to implementing the necessary flashbacks and moments of foreshadowing. This is done through its internal generator, evaluator and implementer:

- **Generator:** For a flashback, one important idea that supports the used implementation is that "if the reader knows that the initiating events are missing or only partially depicted, curiosity occurs; if the reader is not aware of the absence of the initiating events, surprise occurs". So, a set of steps of the plan - which can't negate any preconditions to the following ones - are omitted, and are shifted to a later stage of the narrative. One the other hand, foreshadowing "gives hints to the extent that the reader cannot predict its allusion, but can postdict it in retrospect". This is done by either having a narrative element (character or object) introduced before the proper moment it appears, or by presenting a set of steps with certain elements hidden from the reader.

- **Evaluator:** A flashback is evaluated by checking how the part of narrative that was omitted impact's the reader's overall understanding of the story. In the context of the system, this means that a complete story plan is found, then the omitted steps are expected, and another possible flashback arranged from the existing set of steps. An instance of foreshadowing is evaluated for its postdictability, meaning, if the reader can connect its meaning to the overall narrative after experiencing it. No proper evaluation is done, with the system trusting existing plan.

- **Implementer:** After the generating and evaluating the "new" narrative with the foreshadowing and flashback elements, the system generates a script that can be run by a game engine.

The resulting narratives were then run in a virtual, web-based 3D system called Zocalo.

Again, as with the Suspenser model, Prevoyant offers a proper overview on how to implement storytelling aspects to an existing plot, which, while extremely relevant for my work, are too overly complicated for me to directly try to replicate them, but the theory and ideas behind it were useful propellers for my work.

2.5 Studies of Emotions in Interactive Stories

Throughout the course of modern times, the study of emotions has walked hand-in-hand with works relating to narrative-focused video games and interactive stories in virtual environments. The International Conference for Interactive Digital Storytelling (ICIDS), for example, heavily features works and studies that tackle concepts and examine ideas relating with human emotion, such as empathy and emotional perception, in relation with narratives relayed through virtual systems.

This type of study is advantageous in two correlated ways: the first, and most obvious, is it allows for a better understanding of how the human mind entangles itself into a narrative space and begins reacting in relation to its evolution. But if carefully look the surface of this virtue, you can see another one that I would argue is just as important and begs for further attention: it allows us to tell better, more

involving and rich stories, ones that focus their efforts in specific topics and ideas so as to have their intended audience always engaged.

In the following subsections a few of the more relevant works from recent editions of ICIDS will be detailed, along with exploration of emotion-related ideas. The criteria for their selection was that they had to showcase modern studies where a focused emotion/narrative pairing was essential to their success.

2.5.1 Player Empathy

On one of the studies featured at ICIDS 2017, Jakobsen, Christensen and Bruni explored the idea of choice and moral alignment players have in games being influenced by their empathy with their Playable Character (PC) [24]. They divide the way the player engages with their PC in two opposing ways: goal-related and empathetic engagement. Using this criteria, they classify the relationship the player has with Mario in *Super Mario Bros*[4] as goal-related because "the player does not rescue the princess because they have developed any (pseudo) feelings for her (as in role-playing), but because the goal of the game correlates with the goal of the character (Mario) of rescuing his girlfriend."

The hypothesis for this work was to see if, through a sense of empathetic bonding with the PC, the player would prioritize the internal problems of the character over the main objectives of the game, even if the former went against the latter. With internal problems, Jakobsen et. al refer to "problems that occur in the mind (e.g. conflicts, dilemmas), as opposed to external problems that are found in the environment (e.g. challenges, obstacles)". Three factors correlate directly with the empathetic engagement of the player: recognition ("how the character is presented and interpreted"), alignment ("the player's access to the character's knowledge and affects"), and allegiance("how the character can elicit sympathy by means of its moral appeal"). One example given of a game with empathetic engagement is *Undertale*[5], a game where the player may spare the life of every enemy in the game, something that effectively opposes the main of objective of the PC, which is to escape an underground kingdom filled with monsters.

The way Jakobsen et. al tested their hypothesis was by making two separate versions of the same game, with the only true difference being that, while the control group didn't have any sort of access to the inner-world of the PC, the test group did, with this being done through its internal monologue appearing on screen. A screenshot of the game can be seen in Figure 2.7. First, they devised an External Problem (or Main Objective) that was not emotionally correlated with the PC, then constructed a series of choices, a number of which directly opposing the External Problem of the game, and they built the rest of the narrative and game around these ideas. After the test procedures were done and analyzed, it was concluded that, by giving letting the player see the inner-world of the PC, their choices could be severely influenced, even in detriment to the External Problem.

[4] N. R&D4. (1985) Super Mario Bros. Nintendo Entertainment System
[5] T. Fox. (2015) Undertale

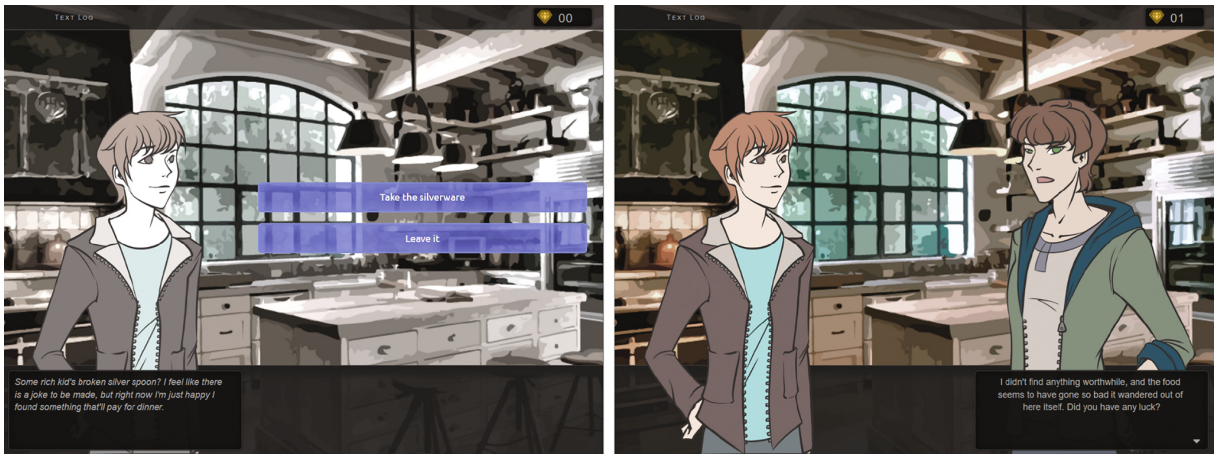

Figure 2.7: A moment of choice (left) and a dialogue interaction (right) in the game of Jakobsen et. al.

The relaying of a non-essential part of the narrative (the use of a subjective inner-monologue) to influence and emotionally entangle the player through empathy, serves as strong evidence that storytelling often makes for more engaging and involving narrative experiences.

One other study towards user empathy is the one Fisher presented at ICIDS 2017 [25]. Essentially, his work seeks to create a correlation between Virtual Reality (VR) and empathy, one that warrants a proper distinction from all others. All artistic media, from literature to cinema, has worked with a particular focus on generating a feeling of empathy in their respective audience in a variety of forms.

What Fisher is trying to do here is to detail how a VR system, given a specific context, uniquely creates this empathetic bond in the user. He gives two forms of empathetic engagement a person can have. The first is *Emotional Empathy*, in which a subject unconsciously begins to see reflected in himself outside feelings, the subject acting then almost as if he is a "reflexive mirror" of emotions. The second is *Cognitive Empathy*, where a person engages with an artwork by trying to comprehend the emotional choices the artist did, thus understanding the artist him or herself through an act of "perspective-taking". Fisher then states that both of these forms of empathy occur with VR, a form of "empathic actuality", because an user doesn't engage directly with the subject of the VR Project, but instead with the VR Designer's interpretation of said subject. He then details that in VR Projects, the unstated main objective every artist and designer seeks to achieve is a sense of "Almost Real Live", giving the experience the closest feeling possible to a real life experience, one that seeks to maximize the feeling that every action the user takes has a direct correlation in the empathic actuality.

A series VR documentaries are described, focusing specifically on how their design boosts the empathic actuality. *Henry*[6] is an interactive experience that seeks to inspire empathy on the user by allowing him or her to close the distance between the camera and Henry, a lonesome hedgehog. Fisher consid-

[6] R. Dau. (2015) Henry

ers this project a “failure” because the passivity forced upon the user, who can do nothing else but move the camera, renders him/her unable to fully close the virtual distance separating the two, thus never approaching “Almost Real Live”. Opposed to this system, the author of the text compliments *Daniel's Story*[7] project, one that allows the user to embody the main character and experience directly the drama of the narrative, where a gay man has to confront the disapproval of his family because of his sexual orientation. This again gives further evidence to how an effective storytelling approach may allow for a deeper emotional engagement from an user/player in an interactive experience.

2.5.2 Emotional Expression & Perception

Battaglino, Damiano and Lombardo made a study on how the correct perception of the moral values assigned to a virtual character would facilitate the user in correctly perceiving their expressed emotions [26]. Their focus on morality-based emotions came from the fact that these sorts of emotions were deemed essential for areas such as narratology (the area that studies the creation and structuring of narratives) and studies about human cognition. Battaglino et. al used the *FATIMA* architecture [27] updated with *Value Component* [28] to build their characters and model their internal moral-based emotional processing and personal goals. With this, the characters are able to express a total of 6 singular emotions (Joy, Distress, Hope, Fear, Pride and Shame) and 4 compound emotions, generated through certain pairings of singular ones (Gratification, Gratitude, Remorse and Anger).

To test their system and hypothesis, a collection of scenes from famous novels were chosen based on how well established were the emotions of the characters portrayed in them, and these were transcribed to the characters in *FATIMA*. The aforementioned scenes were selected with the help of a drama expert and shown to two groups of people: one group that would not have access to information about the moral values of the characters, while the other would have. After the testing process was done, it was concluded that there was indeed a stronger perception of moral emotions when the moral values were known and well-established.

This is a study that showcases how a proper establishing of the character's inner works may help in the perception of its emotions by the reader in a certain narrative context.

One other related, albeit less conventional, work towards the study of Emotional Expression in interactive stories comes from Girina [29], in 2013. The main focal point of this work is in establishing and retracing the ever-growing influence the cinematic language has had over the video game industry, while also developing tools that may allow for a deeper analysis of video game aesthetics. After clearing away the myth that video games are just a form of “interactive cinema”, Girina begins to enumerate the diverse number of fingerprints the film industry has left in modern games and adapts many theoretical

[7] de la Peñna. (2016) Daniel's Story.

concepts about cinema to the context of interactive video games.

The idea of the cinematic narrative, with proper establishment of character motivations and relationships, not only helps give motivation to the player to advance through the game, but also serves to inform many of the gameplay/mechanic decisions the developers make while designing the game. The author then elaborates on *mise-en-scene*, a known cinematic concept that encompasses the combination of every visual aspect of a film into a singular whole. While the creation of a visual package in a movie restricts itself to the contents inside each 2D frame, in most of the modern video games there is a 360º space the developer needs to worry about, making the construction of an appropriate *mise-en-scene* "at least as important in video games as it is in cinema".

Figure 2.8: God of War 3 (2010)

This concept of the video game *mise-en-scene* is then separated into two ideas: Scripted Staging and Expressive Lighting. The first relates to the scripting of involving set-pieces, where it appears that a number of things are happening at the same time and the feeling of grand-scale causality is given to the player. The second, and arguably most relevant for my work, relates to how, given the recent advancements in computer technology, games have been more capable than ever in generating scenarios in which lighting plays a fundamental part in conveying feelings.

As Girina states, "Lighting enables the creation of relationships between multiple elements within and outside the frame, through space and time, characterizing them with certain colors, tones and shades capable of conveying emotions and establishing the mood of a shot, a scene (...)". An example given is taken from the 2010 video game *God of War 3*[8], where a section of the game in the inner world of the tortured protagonist is depicted a completely dark place, with his deep violent past being symbolized through the incandescent glow emanating from the red tattoo he carries on his face and chest (see Figure 2.8).

This is indeed a study that showcases how versatile the concept of storytelling really is, seeing that

[8]S. S. M. Studio. (2010)God of War 3. Sony Corporation.

everything may help convey the narrative, and if done in an emotionally expressive manner, all the better.

2.5.3 The Importance of Emotional Storytelling

In 2011, Zhao, Zhang and McDougall made a study towards explicitly emphasizing the importance of an emotional approach to digital storytelling [30]. Relating to what I previously pointed out in Section 1.2, Zhao et. al claim "the motivation of interacting with (interactive) stories primarily comes from competing with others to achieve these goals rather than empathizing with the characters' experience to enrich emotions and guide story development accordingly," which creates this implicit environment of gatekeeping that keeps other potentially audiences at bay. For the authors, the main objective of emotion-driven interactive stories is to "allow players to adapt narrative storylines in accordance with their experienced emotions," and by creating a successful emotional vicariousness on the player/user/reader, you consequently create a impactful and everlasting experience on him/her.

2.6 Emotional Evaluation and Measurement for Art

One of the big questions surrounding the study of emotions in art and entertainment, be it either in film, literature, video games, music, is how can you effectively measure those said emotions? This is something I also had to face when trying to conceive an effective manner to evaluate the products of my work.

The following subsections will reference works detailing some of the evaluation techniques I took into consideration for my own project, with the last of these being the one I decided to use for my project.

2.6.1 Hevner's Adjective Circle

One of the earlier proposed forms of emotional evaluation of an art form was Hevner's Adjective Circle (HAC), devised by Hevner back in 1936 [31]. It was an adjective checklist used to pinpoint musical stimuli in a formal manner, consisting of a circle of clusters of words, where each cluster had a uniform meaning and the further away clusters were from each other, the less similar were their meanings (see Figure 2.9).

This model was revised a total of three times during the following years, suffering a removal and inclusion of words and clusters, and also changing the questions in which the participants of studies using HAC had to answer. The most recent update to the model was done in 2003 by Schubert [32]. Having tested all the original 67 words devised by Hevner and an additional 23 new words from other models of emotion, with testing being done by asking each subject how appropriate each word was to

evaluate music (Likert scale of 0-7), Schubert devised his own reinterpretation of the model, consisting of 9 clusters with a total of 46 words.

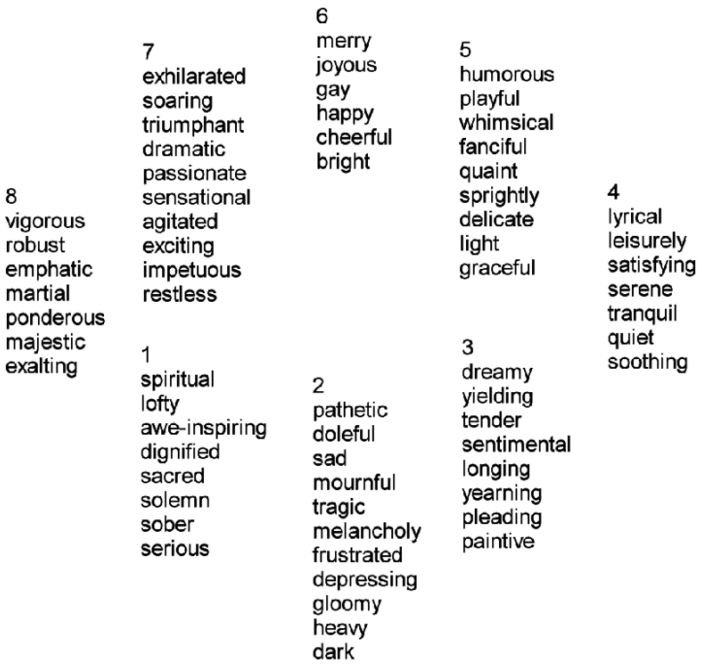

Figure 2.9: The original iteration of Hevner's Adjective Circle

I must point out that this is an evaluative model focused in the evaluation of music, so some of the various adjectives it includes along with its format are not optimized for storytelling mediums, such as film, games and literature fiction.

2.6.2 Need For Affect

One of the paradoxes the study of emotions has unearthed is the fact that we humans, beings motivated primarily to seek out the pleasurable and avoid the unpleasant, are time and time again drawn to dark and depressing tales, such as the ones present in tragedy, drama and horror movies. It is from this starting point that Bartsch, Appel and Storch made a study [33] that sought to "further elucidate the experience of emotions and metaemotions (i.e., evaluative thoughts and feelings about emotions) in horror and drama audiences." For this they used the model Maio and Esses developed in 2001 called Need For Affect (NFA) [34] as a "general predictor of individuals' engagement with emotional media experiences".

As described by the inventors of the model, the NFA is the "general motivation of people to approach or avoid situations and activities that are emotion inducing for themselves and others," meaning that the openness of a person to engage in emotional experiences is "directly proportional" to his/her NFA value. This model is applied using the NFA Questionnaire, with sets of questions that allow researchers

to assess the tendency each test subject has to approach or avoid emotions (an example of a question would be “I feel that I need to experience strong emotions regularly”).

Note that this is a model specifically targets the emotional predisposition people have towards an artistic object, and not their emotional opinion of said object.

2.6.3 The method in “Emotion Elicitation Using Films”

In a paper from 1995, Gross and Levenson studied the effectiveness movies had in inciting particular emotional responses in the context of laboratory work [35]. The advantage of emotional elicitation through film compared with, for example, hypnosis, imagery, the repetition of phrases, is that these are done in a less manipulative and more dynamic manner.

The way in which this idea was validated was by showing sets of 10 clips from a total of 78 films to 31 groups of test subjects (the size of each group varied between 3 and 30 individuals), maintaining a criteria that each film should be watched by a minimum of 25 subjects. After a clip, all subjects had to fill out an emotion self-report consisting of 16 emotions (amusement, anger, arousal, confusion, contempt, contentment, disgust, embarrassment, fear, happiness, interest, pain, relief, sadness, surprise, and tension), assigning each a value of 0-8 in a Likert Scale (0 - “I did not feel even the slightest bit of the emotion”; 8 - “the most I have ever felt in my life”).

The simplicity of this method for emotional evaluation, along with its validation in the work mentioned above made this type of evaluation an initially attractive evaluation method for my own project.

2.6.4 Self-Assessment Manikin

In a study somewhat related with the one mentioned in the above subsection, Uhrig, Trautmann, Baumgärtner, Treede, Henrich, Hiller and Marschall compared films and pictures to see which was the most viable method to elicit emotions on test subjects in a laboratory [36]. Uhrig et. al praise the easy standardization and lack of deception involved in using pictures, and also attribute these qualities to film, along with the dynamism of their movement and the filmmaking techniques used, such as camera movement and sound-design. The main hypothesis of the study was to verify that film clips would be at least just as effective emotional inducers as pictures. For the evaluation, the materials used where the following:

- 80 clips from Hollywood films made between the periods of 1979 and 2007, each with 6 seconds of duration. Half of these clips induced positive emotions (amusement,happiness,love), while the rest induced negative emotions (fear,disgust,sadness);

- 80 individual images, half of which induced positive emotions, while the other half induced negative emotions;

- 80 sequences of 3 images, with the aforementioned even-division by quality of valence;
- A paper-and-pencil, cut-down version of the 9-point Self-Assessment Manikin (SAM) scale, introduced by Lang in 1980 [37], that acquired the values for emotional valence and arousal (see Figure 2.10).

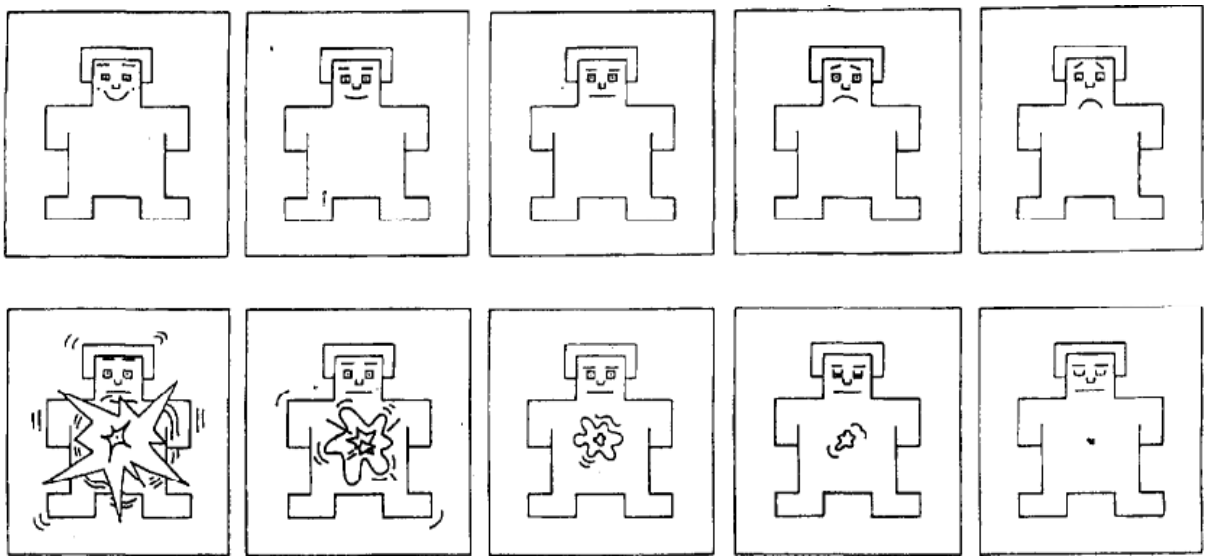

Figure 2.10: SAM figure to evaluate valence (top) and arousal (bottom).

The evaluation procedure, which involved a total of 144 volunteers and was divided into 4 sessions with an average of 35 participants, had them fill out the SAM questionnaire before being shown anything to assess their mood and arousal before the experiment, and, only after this, would the experiment would begin. Then, in succession, each participant was shown an individual image for 6 seconds, three consecutive pictures of the same valence for 2 seconds each, and a film clip of 6s. At the end of each of these three parts, the participant filled out a SAM form.

The SAM form can be seen an effective tool for gathering the subject's emotional information before and after an experiment, while also being a relatively simple method, warranting heavy consideration for my work. However, it does not offer much detail in regards to emotional valence.

2.6.5 Differential Emotions Scale and PANAS

Again in a study about the effectiveness of film as an emotional elicitation tool, Schaefer, Nils, Sanchez and Philippot devised a a comprehensive set of emotional clips of various films, showcasing a varied array of emotions (from fear to tenderness, without also excluding neutral emotional states) [38]. The objective of the researchers here is very much in sync with the ones of the previous two subsections of this document.

The material used for the experimental procedure of Schaefer et. al consisted of 70 movie clips, with the duration of each varying between 1 and 7 minutes. The films and clips were selected by 50 film experts. 7 random groups with an average size of 52 participants were presented with 10 movie clips, with the restrictive criteria that two clips showcasing the same emotion couldn't be played one after the other and only a maximum of two films with the same valence could be watched in succession. After each clip, all participants were asked to answer a questionnaire with 3 separate measures:

- **Self-reported emotional arousal** - A self-assessed measurement of the emotional arousal the subject suffered during the movie clip. Done using a Likert scale of 1-7 (1 - "I felt no emotions at all"; 7 - "I felt very intense emotions").

- **Differential Emotions Scale** - To measure discrete emotional dimensions, a modified version of Differential Emotions Scale (DES) [39] was used, with the original 10 groups of emotional adjectives plus 6 additional ones. 5 of these groups consisted of positive emotions, 8 of negative ones, and the remaining 3 consist of emotions with high arousal, but no specific valence. To give an example, the second group of adjectives of DES, and also the first positive one, is *(Joyful, happy, amused)*. To rate each group of adjectives in accordance to what they felt during a film clip, each individual used a 1-7 Likert scale (1 - "I felt no emotions at all"; 7 - "I felt very intense emotions"). This version of DES was previously validated in two studies. [40, 41].

- **PANAS** - The PANAS scale [42] is used as a self-reported adjective checklist containing two separate 10-item subscales of emotions, one for Positive Affect (PA) and other for Negative Affect (NA). The manner in which the subject felt each emotional item is evaluated with a 1-5 Likert scale (1 - "very slightly or not at all"; 5 - "extremelly").

From all of the models mentioned in this section, this is the most complete as a manner of correctly assessing the emotional state of an individual before and after being exposed to an artwork. In the case of this work in particular, it was used for evaluating the emotions caused by movie clips, but nothing restricts it to that form of specific content, so this sort of evaluation is the one my work will be mainly using (albeit with some slight modifications).

2.7 Emotional Differentiation in Genders

When I reached the middle point in the development of my project I was faced with an unexpected question: in which manners does the expression of emotions vary between men and women? We often hear the stereotyped remarks that women more easily display their joy and sorrow than men, who, due to a more emotionally restrictive education, have a tendency to be much more discrete. And according

with many studies, the conclusion reached is very much in line with the one usually associated with the stereotypes.

In a paper released in 1999, Kelly and Hutson-Comeaux [43], along with their own investigation on context-specific gender emotions, gathered many of the conclusions already reached in this type of study: a differentiation in emotional display between both genders is progressively accentuated with age, with men bearing a social pressure that inhibits them from expressing their emotions, and not from feeling them. The most unexpected conclusion gathered before the text of the authors was that the gender difference impacted emotional experience when situational factors give more salience to gender itself, described by Kelly and Hutson-Comeaux in the way that "women tend to report greater emotional experiences than men in situations that involve interpersonal rather than impersonal emotion elicitors," and this was something that the results of their tests agreed with.

This type of study was useful in helping me add emotional realism to one of the virtual elements of my work. Albeit not the most important aspect of the project, it was sufficiently relevant to warrant itself a section in this document.

2.8 Summary

This chapter of the document divided itself into two parts.

In the first part (**Interactive Narratives**), from Section 2.1 up to (and including) Section 2.4, I gave context to what constitutes a narrative, detailed some of the existing methods of storytelling and narration, gave a few examples of interactive stories, and explained the two main models used as inspiration for my Narrative Generation system.

In the second part (**Emotion Studies in Narrative**), I described in detail various studies of emotion done with Interactive Stories and video games, detailed a few of the possible methods for emotional evaluation of artistic and entertainment elements, and finally gave a brief description on the emotional differences between men and women.

In the following chapter of this document, I will describe and explain the idea and implementation that makes up the core of my project.

3

Implementation

Contents

In this third chapter of the dissertation, I describe my main work hypothesis: the creation of a system that takes narratives as input and, using a virtual emotional model specifically developed for this project, manipulated these in order to maximize one of two opposing emotional tones, and also introduces one of two turn-taking approaches in terms of narration. In the following sections, I will be detailing my each of these elements in detail.

3.1 Development Tools

For the development of this project, a total of 3 tools were used. A description of each of them is featured in the following subsections.

3.1.1 Yarn

For the creation of the narratives my system will work with, I used a dialogue editor called **Yarn** [44]. This is a program that was originally developed for the video game *Night in the Woods* [1], but since then made open-source by its developers. It allows its user to easily create branching instances of dialogue between multiple characters and the user. To do this, dialogue nodes specify which character is supposed to talk, what will be said and in what order; also, through directed connections, a variety of scripted dialogues paths can occur. An example of a possible dialogue tree in Yarn can be seen in Figure 3.1.

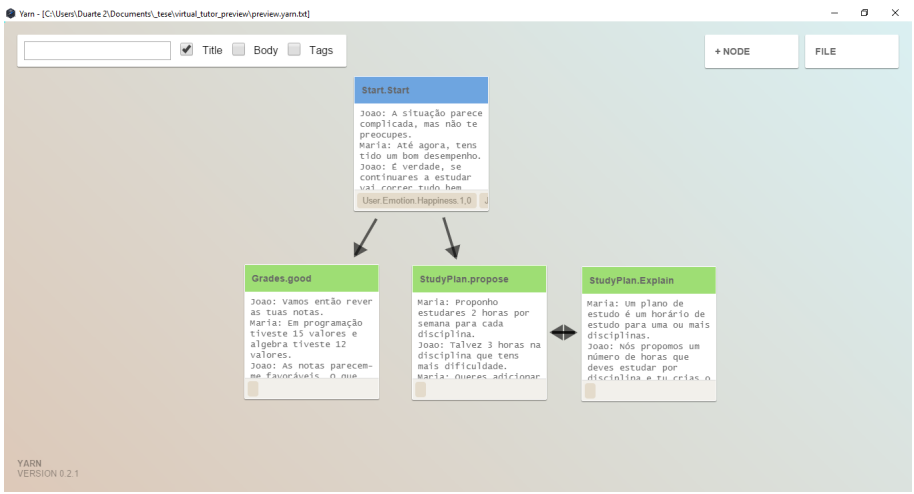

Figure 3.1: Example of a Yarn branching dialogue tree, interpreted from a single yarnfile.

The file containing the contents of a series of yarn dialogues is called the **yarnfile**. Its contents are interpreted by the Yarn program and it generates the appropriate visual nodes and connections. In this work however, manipulation of the yarnfile happens directly on the file itself. When opened in a text

[1] I. Fall. (2017) Night In The woods. Finji.

editor, the contents of the yarnfile are as seen in Figure 3.2. In this specific case, we can see the internal

preview.yam.txt

```
1  title: Start.Start
2  tags: User.Emotion.Happiness.1,0 Joao.Emotion.Neutral.0,9 Maria.Emotion.Happiness.0,5
3  colorID: 1
4  position: 539,256
5  ---
6  Joao: A situação parece complicada, mas não te preocupes.
7  Maria: Até agora, tens tido um bom desempenho.
8  Joao: É verdade, se continuares a estudar vai correr tudo bem.
9
10 Joao: Gostavas de discutir as tuas notas?
11 Maria: Ou talvez fazer um plano de estudo?
12
13 [[Ver Notas|Grades.good]]
14 [[Plano de Estudo|StudyPlan.propose]]
```

Figure 3.2: Text content of a node inside the yarnfile.

textual representation of the Start.Start node previously seen in Figure 3.1. In it, line 1 declares the title of the node, line 2 relates to special tags used by the writer/developer for special custom functions, line 3 is the visual color of the node, and line 4 is its position in the UI of Yarn. Lines 6 through 11 are the main body of the yarnfile, in which dialogue is written along with the names of the characters that will recite it, and finally, lines 13 and 14 are for the user to choose his own dialogue.

In order to normally integrate Yarn into a program or application, Yarn Spinner [45] is needed. This is a Yarn interpreter developed in C# that parses the coded text in the yarnfile into data format a desired program may interpret and run. However, in the context of this work, in order to allow myself a more customized and less restricted organization of the yarnfile data, I decided to deal with the parsing of the yarnfile on my own.

3.1.2 Virtual Tutor

Virtual Tutor (VT) is an Android app developed by 4 students of Instituto Superior Técnico, with 3 of them working on this tool in the context of their own projects for the master's degree [46–48].

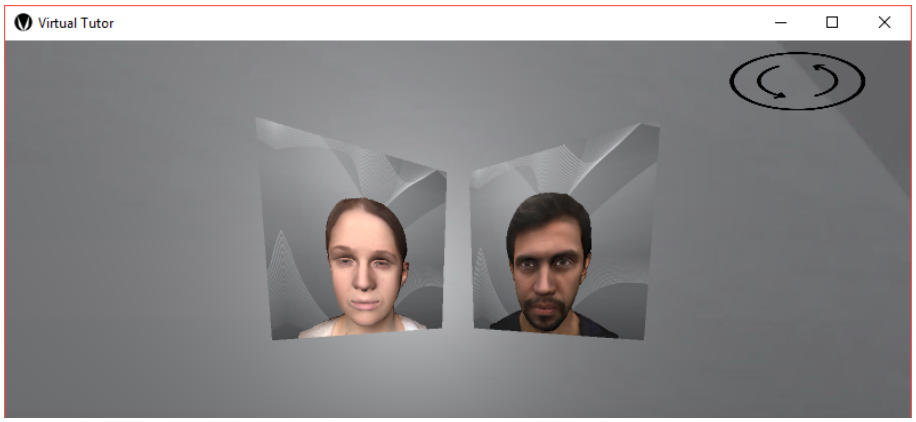

Figure 3.3: The two NPC Storytellers/narrators of the Virtual Tutor system: Maria (left) and João (right).

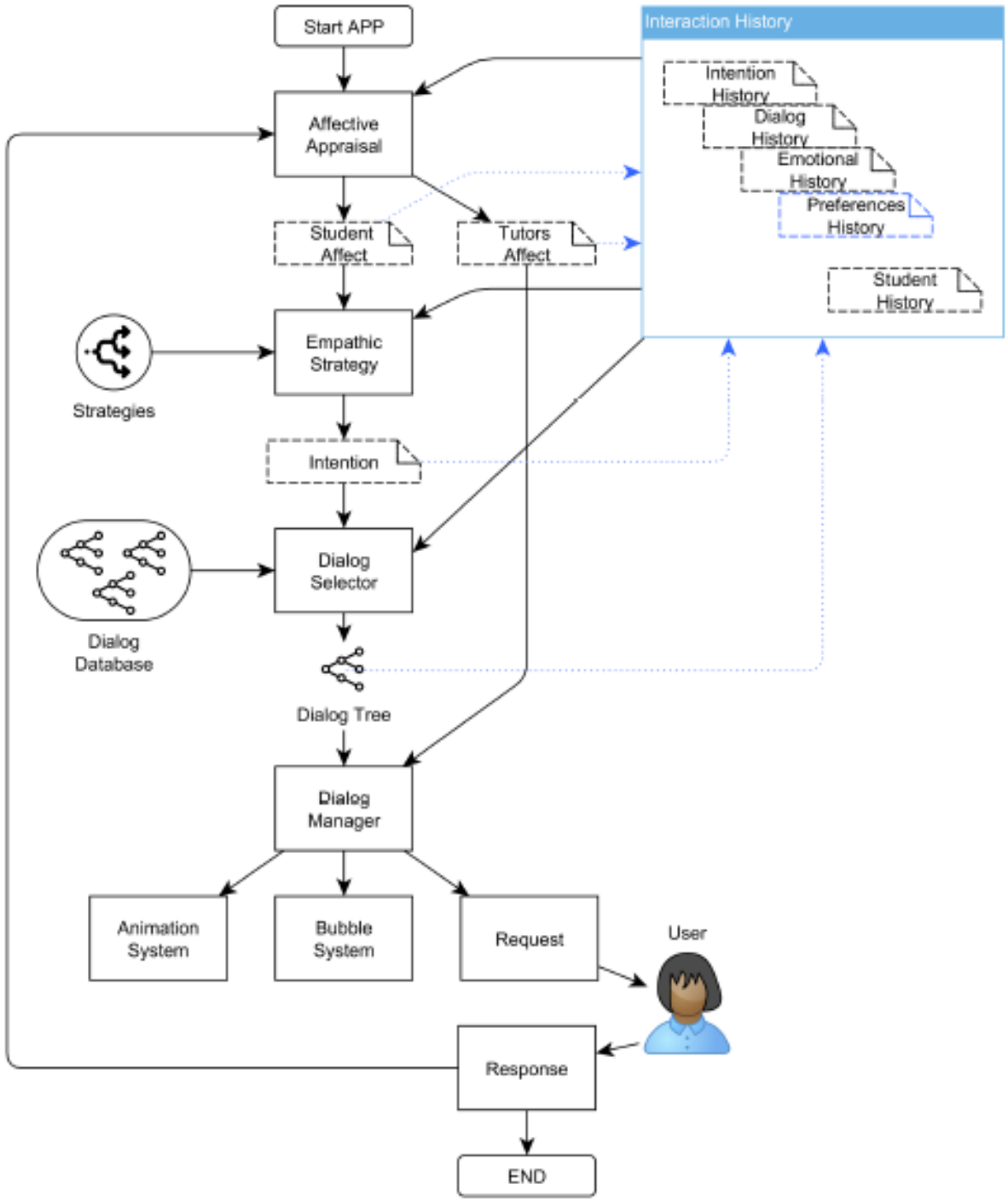

Figure 3.4: The architecture of the Virtual Tutor System

This app was built with the purpose of helping students organize their study, while also providing feedback regarding their academic results that could be useful [49]. This is done by two virtual characters who serve as the personal tutors of the user. For the context of this work, however, these two characters are referenced as **NPC Storytellers**, or simply as narrators, as seen in Figure 3.3.

The characters in VT feature an internal emotional spectre comprised of a total of 7 emotions: Neutral, Anger, Happiness, Sadness, Fear, Surprise and Disgust. Each of these emotions has an associated intensity value that ranges from 0 to 1, and expresses how strongly a said character is currently feeling it. These emotions can be visually seen by the player through the facial expressions of each character, along with their respective dialogue bubbles. For example if one of them has a value of 0.7 for the emotion Happiness, he or she will be visibly smiling and will have a more joyful demeanor towards the user. The way these emotional values can be manipulated is through the already mentioned tags in a yarnfile, which are related to a certain dialogue node. There also exists a special array of tags that can be used in the main body of the yarnfile that can manipulate the emotions and overall expressiveness of the characters (these are not shown in Figure 3.2).

The architecture for the VT system can be seen in Figure 3.4. As described by Pereira [48], when the system is booted it calculates a value of affective appraisal that takes into account preceding interactions and preferences the student had with the system and its two virtual characters. With this value, the affective state of both the tutors and the student is calculated, which guides the system in selecting and changing the appropriate empathetic strategy as time goes on. From this strategy several things may occur, such plans for study and specific dialogue interactions. These things are visually expressed by a combination of facial and textual animations.

For the context of this work however, we use a limited amount of the functionalities VT offers. Specifically, the focus here is in how VT operates over a yarnfile. To run a Yarn dialogue in Virtual Tutor, one must simply indicate the path for the yarnfile and press the play button. Then, the two NPC Storytellers will continuously read through their dialogue in a node until it either asks the player to choose a dialogue option (changing then to another dialogue node for the NPCs), or finds the an exit command, which ends the dialogue interaction. Specific commands written in the yarnfiles can directly trigger emotional reactions in the NPC Storytellers.

3.1.3 Unity

Both of the systems mentioned above are conjointly used with the Unity Engine [50] (Version 2018.3.2), a game-development engine widely used for the development of independent games and virtual environments. It operates on C# language, with a special focus on Object-Oriented Programming. The VT system was developed from the ground-up in Unity, so it was decided that this engine would be the best choice to develop my proposed solution.

3.2 Storytelling System Architecture

My storytelling system serves as added extension to the VT system, meaning that no modifications besides a few bug fixes were made to that system. As seen in Figure 3.5, the Storytelling process is divided into four distinct main phases, all sequenced and organized through the Storytelling Manager of the system. In the following subsections, an overview of each of these phases will be done.

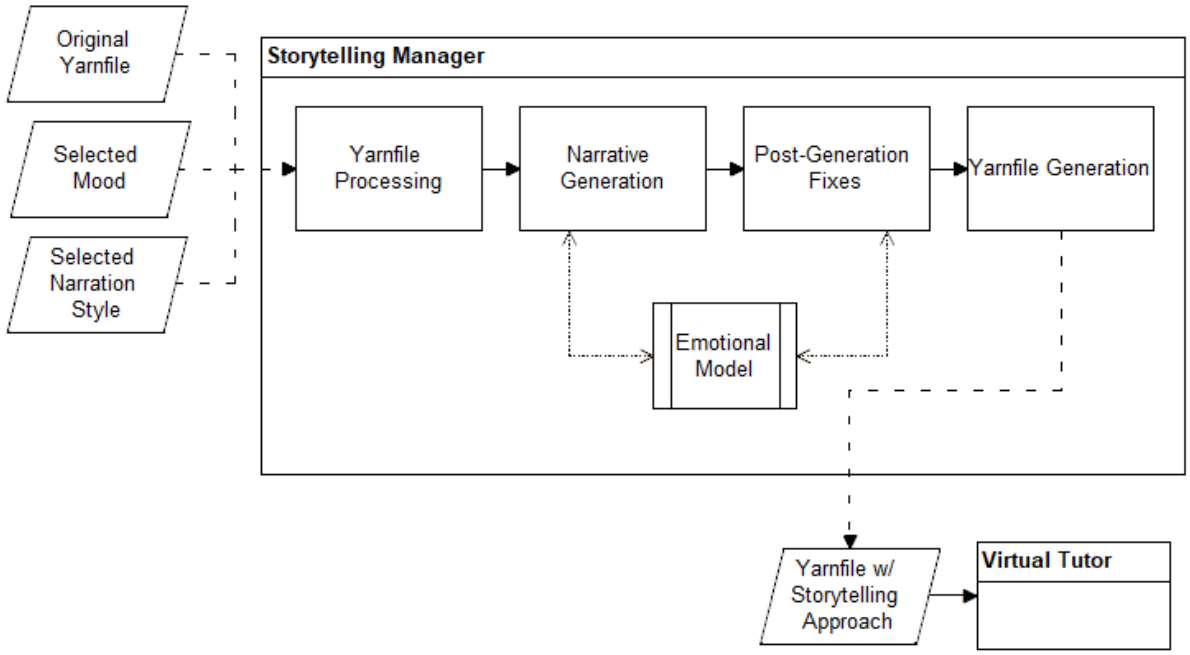

Figure 3.5: The architecture of the Storytelling Pipeline

3.2.1 Yarnfile Processing

The first phase of the Storytelling insertion process consists in in the pre-processing of the input yarnfile into the system.

Before the phase begins however, the user selects the path for the desired yarnfile (one that a user created before using the system), the desired emotional mood (Happy or Dour), or the desired Narration Style for the NPC Storytellers. The two latter choices do not influence this phase of the process, so they will not further mentioned in this Subsection.

With the path for the yarnfile, the system reads through text lines and, from them, generates the appropriate set of node objects for the narrative. Through the aforementioned use of tags, the system manages to extract some useful information for the latter stages of the Storytelling pipeline. These tags are *Index* (integer value representing the chronological position of the node in the narrative) and

IsEssential (boolean value that says if that said node is essential for the understanding and integrity of the narrative). As it was already previously mentioned, a different set of tags is used inside the body of each node, but these will be detailed in Subsection 3.3.1 since they relate with the developed emotional system. Each node in the yarnfile is separated through the use of "===".

The end result of this phase is a list of nodes that will be used by the following phase of the Storytelling pipeline.

3.2.2 Narrative Generation

After obtaining the list of nodes, comes the process of obtaining the **best version** for the narrative. What is meant by "best version" is a sequential iteration of the narrative nodes of the original yarnfile that maximizes the mood the user selected at the moment of input. More specifically, if the user wants a narrative with a "Happy" mood, the nodes of the narrative considered by the Emotional Model as being more depressing/violent/sad are less likely to appear in the chosen "best version" of the narrative. The opposite applies if the player chooses a narrative with a "Dour" mood, resulting in a narrative with less joyful nodes because the Emotional Model seeks to have them removed from the chosen narrative (more details on this further down this chapter). Note that a node may only be omitted if one of its tags describes it as being a non-essential node (*isEssential:False*).

This phase is divided into two parts.

In the first, we take the list of nodes obtained in the previous phase and generate a list containing all of its possible permutations. What this means is that every possible combination of essential and non-essential nodes (with the nodes of each ordered in chronological order by the Index tag) is generated and stored in a list. For example, if we have a narrative with 3 essential nodes and 5 non-essential ones, a total of $2^5 = 32$ possible narratives exist, since nodes can only be omitted, and not reordered. This approach was deemed sufficient for the closed context of this work, but in order to support some form of future escalation, the method of narrative generation needs to be reworked into something more sophisticated and efficient.

In the second part, we use the internal Emotional Evaluation model (detailed in Section 3.3) to evaluate the emotional value of each of the generated narratives according with the emotional mood the user previously selected and then choose the most suited of all. This selected narrative will be transitioned to the next stage of the Storytelling Pipeline.

3.2.3 Post-Generation Fixes

After having selected the most suited narrative (i.e. set of nodes) for the user-selected mood, this phase of the pipeline adds three fixes to it.

The first changes the way the two NPC Storytellers will alternate the narration of the narrative between themselves in VT. Narration can either be alternated between the NPC Storytellers in a periodic fashion (i.e. from node to node), or they change between themselves whenever a proper variation of the emotional value of the narrative occurs mid-node (again, this will be further explained in Sec. 3.3).

Next, emotional expressions tags are added to the nodes in order to have the NPC Storytellers visually emote according with the emotional developments of the narrative (again, see Sec. 3.3 for more details on this).

Finally, the nodes need to have the information VT requires to support the transition between nodes, so this is added to the body of the node, along with an option for the user to repeat the node if he/she so wishes. In practical terms, when the NPC Storytellers of VT reach the end of a node, the user will be presented with two choices, one that jumps to the following node and other allows for the current node to be repeated (useful if the user wishes to repeat the node).

3.2.4 Yarnfile Generation

This final phase simply consists in exporting the set of nodes into a new yarnfile and signaling the VT system that it can begin processing it. After this, the user can run the generated narrative in Virtual Tutor.

3.3 Emotional Storytelling Approach

The core element of the system I developed lies in the Emotional evaluation system that directs the Storytelling process previously mentioned in Subsections 3.2.2 and 3.2.3. This model essentially allows the system to infer the overall emotional mood of a narrative. when iterating trough each narrative node in search of its Objective Values and, by an ongoing valued classification of groups of these, you end up obtaining the overall emotional mood value of a narrative, along with its variation along the course of the narrative.

In the course of this Section, all of the components that go into this will be fully explained. For this, I will be dividing this explanation in different subsections, each containing the details for one of the aspects of the emotional evaluation method.

3.3.1 Objective Tags

One of the main questions I had in the beginning of the development of this project was ”how can the internal emotional variations of a narrative be relayed in a straightforward manner?” Seeing that an overly complex and intricate emotional system along the lines of those works I took inspiration from was

beyond the scope of this work, what I sought to do was to condense the idea of emotional variation into a more simple idea. In the end, what was concluded was that the objective(s) of the main character(s) could be used as the basis for the emotional system. If a character is getting close to its objectives, then it can be infered that there is a happier mood to that part of the narrative. If a character is completely out-of-reach of any of its objectives, then the mood of the narrative is interpreted as being darker and more dour. Having this figured out, the next step was to determine just how this could be represented inside the yarnfile.

This was done by adding tags with the format of <<**OBJECTIVE:XX; sec_objective:YY, ...**>> in the Body Section of each node in the yarnfile. An objective is represented by an upper-cased name (**OBJECTIVE**) if it is a main objective and by a non-spaced, lower-cased custom name for the secondary objectives (**sec_objective**), both of these types having a value ranging from -1 to 1 saying just how close to that objective the main character is (**XX, YY**). More than one objective is supported (the main objectives have to all appear first in the tag, followed by all of the secondary ones), with the separation of objectives being done by the use of semicolons ";". The continuous variation of the objectives of a character is something that has to be done by the writer of the narrative. He/she is responsible for discerning just how the objectives change with the development of the narrative, and adding tags accordingly. The writer also has to keep track of what the main objectives mean given the fact that they can only be named as **OBJECTIVE**. This decision in restricting the names of the main objectives was made in order to force the writing of simpler narratives for this version system, seeing that it serves more as a proof of concept than a fully-fledged narrative generation system, and it would not be able to handle very complex narratives with a high number nodes, characters and objectives. An example of a yarnfile node containing objective tags can be seen in Figure 3.6.

```
Maria: She came to a point where the cave became slightly wider, and the ceiling much taller,
Maria: so much so, that the light of her torch couldn't even reach it.
<<OBJECTIVE:0.3; Calm:-0.1>>
Joao: As her chest tightened, she drew Sear.
Joao: Any sign of shifting movement, any slight noise at the edge of earing,
Joao: any whiff of decayed flesh, any pair of eyes glowing in the midst of the gloom,
Joao: her senses and muscles were ready to respond accordingly.
<<OBJECTIVE:0.3; Calm:-0.3>>
Maria: The trail ended abruptly.
Maria: As if in one moment the blood was steadily falling to the ground,
Maria: and in another it had suddenly been cut off.
<<OBJECTIVE:0.3; Calm:-0.7>>
Maria: A deep, guttural snarl, almost mocking in tone, came from behind her.
Maria: And when she turned around, she saw Its two slitted yellow eyes,
Maria: both screaming silently for her blood and flesh.
Joao: She wasn't surprised.
```

Figure 3.6: Example of the use of various objective tags in a single narrative node (lines 3, 8 and 12).

Note that the VT system has self-sufficient manner of verifying these tags, meaning that, if it knows what the tag means, it will process it; otherwise, it will just ignore it and move on. Knowing this, the

obvious manner in which the variation of the objective of a character could be represented was by a specific tag.

But how are these tags used by the Emotional System? This is what the following Subsection will answer.

3.3.2 Emotional Model: Choosing the Best Narrative

The main idea here was to have an **Emotional Model** that, by using the values of the objective tags and analysing how these vary throughout the yarnfile, calculated an approximation to the global emotional value of the narrative. So how does this Emotional Model evaluate a narrative?

For the first step, what this Model does is essentially a joint evaluation of the values of all consecutive groups of 3 objective tags throughout the entire course of the narrative. An Objective Value is calculated by adding the full value of each main objective with half the value of each secondary objective. From here onward, the first Objective Value will be called $obj1$, the second $obj2$ and the third $obj3$. If I use the objective tags present in Figure 3.6 of the previous Subsection, and consider the current tag ($obj3$) as the one in line 12 of the image, then $obj1$ tag has a value of 0.25 ($0.3 - 0.1 * 0.5$), $obj2$ has a value of 0.15 ($0.3 - 0.3 * 0.5$) and $obj3$ has a value of -0.05 ($0.3 - 0.7 * 0.5$). This is a process that is executed from the very first existing objective tag in the narrative, meaning that in such a case there are two Objective Values that have to be pre-defined in order to make up for their non-existence. So, these are assigned with 0. Again referring to Figure 3.6, if we consider its first objective tag in line 3 as the current one being analysed, we consider it to be the $obj3$ with a value of 0.25, while $obj1$ and $obj2$ are assigned a value of 0. The same sort of idea applies to the second existing tag of the document, which requires an $obj1$ of value 0, while $obj2$ has a value of 0.25 and $obj3$ is assigned the value of 0.15.

For the second step, we determine what we call the Mood Variation value from the manner in which the trio of Objective Tags varies in value. As seen in Figure 3.7, there are 9 possible types of variation in values, each with an associated integer value ranging from -3 to 3. The Mood Variation value represents the valence for the mood in a group of three objective tags. A negative value means negative valence (more Dour), and a positive one means positive valence (more Happy).

From these 9 possible types, we can extract 4 different types of classification:

- **Mood Variation value is 3** if there is a negative spike value in the middle of the group of 3 Objective Values. For example, if we see a sudden decrease happen from the first to the second Objective Value, only then to see the third one having a significant rise in value, it means that some sort of pleasant occurrence suddenly happened in the narrative. This is accounted as being a positive narrative surprise.

- **Mood Variation value is 2** if there is a successive increase in the values of the three Objective

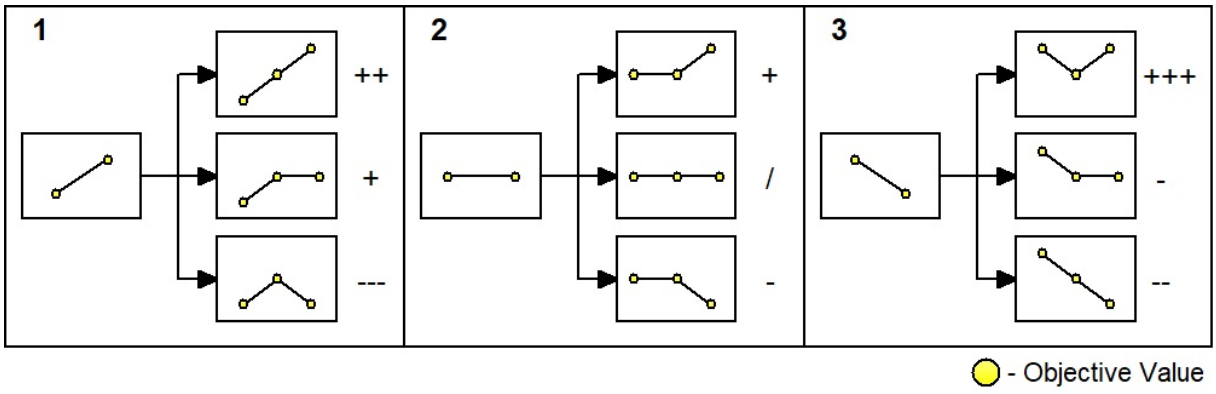

Figure 3.7: Diagram of the various types of Mood Variation, along with the respective classification.

Values;

- **Mood Variation value is 1** if the first couple of Objective Values are considered equal in value, and the remaining Objective Value is of a greater value than then. Or, if the last pair of Objective Values are considered equal, and both are greater than the first one.

- **Mood Variation value is 0** if the three Objective Values are considered equal. Note that in order for Objective Values to be considered equal, the absolute value of the difference between each pair of the three nodes must not be superior to 0.1. This means that an Objective Value of 0.5 and another of 0.55 are internally viewed as equal because their variation is considered negligible. This margin value of 0.1 was chosen because it proved to not be too strict, but also did not allow smaller variations to be considered;

- **Mood Variation value is -1** if the first couple of Objective Values are considered equal in value, and the remaining Objective Value is of a lesser value than then. Or, if the last pair of Objective Values are considered equal, and both are of lesser value than the first one.

- **Mood Variation value is -2** if there is a successive decrease in the values of the three Objective Values;

- **Mood Variation value is -3** if there is a positive spike value in the middle of the group of 3 Objective Values. For example, if we see a sudden increase happen from the first to the second Objective Value, only then to see the third one having a significant drop in value, it means that some sort of unpleasant occurrence suddenly happened in the narrative. This is accounted as being a negative narrative surprise.

Using this information, let us use the Objective Values in the example given in Figure 3.6 to see how they would be classified. We have three Objective Values: $obj1 = 0.25$, $obj2 = 0.15$ and $obj3 = -0.05$.

Seeing that $obj2$ is inferior to $obj1$, then we will be looking at the third square of Figure 3.7. Since $obj3$ is also inferior to $obj2$, then this trio of Objective Values is classified with a Mood Variation value of -2.

After obtaining the Mood Variation value, we generate the Current Mood value. This is done by calculating the absolute value of the difference between $obj3$ and $obj1$, and then multiplying it by the Mood Variation value of the current group of 3 Objective Values. The formula for this is the following:

$$CurrentMoodValue = |obj3 - obj1| * MoodVariationValue$$

This is a required calculation because we need a precise manner in which to measure the exact way the trio of Objective Values varies.

Consider the following two examples: we have Trio 1 consisting of $obj11 = 0.2$, $obj12 = 0.3$ and $obj13 = 0.4$, and Trio 2 consisting of $obj21 = 0.2$, $obj22 = 0.6$ and $obj23 = 0.9$. Both of these groups are classified with a Mood Variation value of 2, but it is evident that there is a much stronger evolution in the Objective Values of Group 2 than in the ones of Group 1. So we use the absolute value of the subtraction between the last and first Objective Values in order to represent this. The absolute value is then multiplied by the Mood Variation value, thus creating the Current Mood value, which is then added to the Total Emotional Value (TEV) of the narrative currently being analysed. In this case, the Current Mood Value for Group 1 is 0.4, while the one for Group 2 is 1.4.

When all groups of three consecutive Objective Values are evaluated, then the final TEV is obtained and the narrative evaluation ends. A Happy narrative is expected to have a high positive TEV, and a Dour narrative is expected to have a low negative TEV.

Relating this with the process described in Subsection 3.2.2, from the total list of generated narratives, the system chooses the best narrative according with best existing TEV value. If the user of the system wants a Happy narrative, the system will deliver the narrative with the highest TEV; otherwise, the user desires a Dour narrative, so the system produces the narrative with the lowest TEV.

3.3.3 Emotional Model: Narration Exchanges and Emotional Expressions

One other thing this emotional model generates is a list that stores the ways in which the pairs of Mood Variation and Current Mood values evolve along the selected best narrative. This is useful for a couple of the fixes and add-ons mentioned in Subsection 3.2.3.

The first of these fixes changes the way in which the two NPC Storytellers alternate between themselves while narrating the narrative. VT requires the name of one of the NPC Storytellers in the beginning of each line of the narrative body of a node, and since this project seeks to help punctuate the emotional resonance of a narrative, it was concluded that the manner in which the two narrators alternate between themselves may help or hinder this very aspect.

Depending on what the user of the system chooses, the NPC Storytellers may alternate between themselves from node to node or switch according to the variations in the mood of the narrative. Focusing specifically on the latter type of narration, by using the list of paired values mentioned in the beginning of this Subsection, more specifically the way in which the Current Mood values evolve along the narrative, the system alternates the narrator in the yarnfile according with the manner in which the mood evolves in the narrative.

When a noticeable increase happens between two successive Current Mood values and the current narrator is João, Maria becomes the new narrator. If instead of this a noticeable decrease in the two successive Current Mood values happens and Maria is the current narrator, then the current narrator is switched to João. Otherwise, the current narrator is maintained. The minimum absolute value for an increase or decrease in Current Mood values was defined as 0.5, which proved to be sufficiently high to stop the system from changing narrators on an hyperactive manner, but small enough to allow alternation to happen in a regular manner that reflected the emotional flow of the narrative.

Due to the information taken in consideration in Section 2.7 about the ways men and and women express emotions, it was fitting that Maria was the narrator whenever the narrative progressed in a more joyful manner and João narrated whenever the narrative ventured into its darker sections. In Figure 3.8 a

```
<<OBJECTIVE:-0.5; Calm:-0.6>>
Joao: The blood trail she was following led to an enormous cave.
Joao: It's entrance, a wide-open mouth of dark gloom ripping out of the body of the hill's wall,
Joao: broken and sharp stalactite and stalagmite fangs in wait of any entering prey.
<<Nod Maria Start>>
Joao: Grabbing a broken oak branch from the surrounding treeline, she took a bundle of dead leaves,
Joao: wrapped them around one of the branch's ends with some linen cloth soaked in old licor and,
<<Nod Maria Stop>>
Joao: after unbuckling Sear, her blade, from its sheath, she waved it for a few seconds in the air
Joao: and pressed the scalding blade on the wet cloth.
<<OBJECTIVE:0.0; Calm:0.0>>
Maria: It caught fire instantly.
Maria: Now, the moment she feared, the moment she eagerly waited for, was at hand.
Maria: Up-and-down shivers needled the skin of her back and neck.
Maria: Sweat filled the inside of her trembling leather gloves.
```

Figure 3.8: Section of a yarnfile where both a change in narrator and a nodding command happen.

change in narrator can be seen when an improvement in the values of the objectives towards the bottom of the image makes the system change the current narrator from João to Maria. Two additional things can also be seen in this image.

The first is that, before the main emotional commands for each narrator, you can see a command that assigns them a **Neutral** emotion. Each of the virtual characters can feel multiple emotions at once (simultaneous happiness and sadness, for example), but for this work it is only desired that they express a single one at any given time. So, in order to reset their inner emotional status, the Neutral emotion is given to them, which has the effect of setting all other emotional values of theirs to 0.

The second is the command **Nod** command. This is done while the chosen form of narration changes

Mood Variation Value	Maria	João
-3	Sadness: 1.0	Fear: 1.0
-2	Sadness: 0.5	Fear: 0.5
-1	Sadness: 0.2	Neutral: 0.5
0	Neutral: 1.0	Neutral: 1.0
1	Happy: 0.2	Neutral: 0.5
2	Happy: 0.5	Surprise: 0.5
3	Happy: 1.0	Surprise: 1.0

Table 3.1: Table describing how the emotions displayed by the NPC Storytellers change according to Mood Variation values.

is being applied. Essentially, it makes the currently silent NPC Storyteller nod its head in a randomly periodic manner, in order to give the illusion that its actively engaging in the narrative despite being silent. The nodding period randomly varies between 2 to 6 lines of text. In the example of Figure 3.8, Maria nods during two lines of text narrated by João and then is commanded to stop.

The second type of fix/add-on that uses the list of paired values is the one that introduces command tags in the narrative body of each node for the NPC Storytellers to visually emote according with the emotional mood the narrative is taking.

As it was already mentioned, both of the NPC Storytellers of the VT system support a total of 7 emotions with values ranging between 0 and 1, but for the context of this narrative we unly use 5: Neutral, Happiness, Sadness, Fear and Surprise (Anger and Disgust were discarded for the context of this work, seeing that they did not fit inside the context of the narrative used during the testing process). Again taking into consideration the emotional differences between men and women referenced in Section 2.7, Maria was assigned the possible emotions of Happiness and Sadness (focus on valence), while João could emote Fear and Surprise (focus on arousal). The idea for this came from the studies seen in Section 2.7, which discerned how emotions varied according to gender. Women tend to have a higher tendency to express emotion high in both arousal and valence, while men have a lesser tendency to express emotions with high valence. So, I assigned the two emotions with a higher valence to Maria, and the other two to João. Note that both NPC Storytellers are allowed to express the Neutral emotion.

These emotions are expressed by a combination of simulated facial expressions (developed by Silva [47]) along with stylized dialogue balloons (developed by Pereira [48]). Each of the listed Mood Variation values of the narrative is used whenever its respective Objective Value tag is reached, so the system can properly introduce emotional expressions in those precise moments of the narrative body.

In Table 3.1, the correspondence between each Mood Variation value and the respective emotional expression assignments is specified. Maria only has a Neutral emotion when the Mood Variation value

```
Maria: That was one of the happiest nights of Kali's life.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Happiness 0.5 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Surprise 0.3 None>>
<<OBJECTIVE:0.1; Calm:0.0>>
Maria: Kali smiled at the thought,
<<Nod Joao Stop>>
Maria: and the looming darkness felt like it had lost some of its initial weight on her.
Maria: She walked on, blood trail still underneath her heels.
```

Figure 3.9: Section of a yarnfile where the emotional expression commands are used in accordance with a Mood Variation value of 2.

Figure 3.10: NPC Storytellers emoting according with the command tags on the used yarnfile.

remains constant, meaning that she is more sensitive to emotional changes in the narrative. On the other hand, João only reacts to stronger emotional variations, meaning that Mood Variation values of -1, 0 or 1 have him reaction in a Neutral manner. And also, note that even the Neutral emotion has values associated with it, meaning that there are several degrees of neutral expression in the facial expressions and dialogue bubbles of the characters.

In Figure 3.9 you can see how this is specified in an example yarnfile, and in Figure 3.10 you can see this same yarnfile being run on the VT system, with the two NPC Storytellers having noticeable facial expressions and the Maria NPC having its dialogue bubble in accordance with her happiness.

Relating all that was mentioned with the idea of Interactive Stories featured in Section 2.3, my proposed system can be described as containing components very much inspired by the ideas behind the Drama Manager and the Agent Model. However, calling my system a provider of Interactive Stories would be fallacious, since it does not have a proper AI core that operates along with the development of the narrative.

It is through this combination of emotionally focused systems that this work seeks to prove the effectiveness of storytelling in the emotional impact of a narrative. The choices of switching narrator, having them visually emote and react to specific occurrences, finding the best intended version of the narrative with the right amount of sections omitted, all of it is targeted at enhancing the narrative experiences of

an audience.

3.4 Summary

In this Section, I detailed the tools used for the development of this project, gave an overview on the tasks and architecture of the developed system, and explained how its emotional model worked and in what contexts. In the next Section, I will be discussing how I put developed the experiments that served to test my initial hypotheses for the project.

4

Experimental Evaluation

Contents

4.1 Problems Approached

As specified earlier in Section 1.2, the core issue this work is trying to find an answer to is "how can we develop a system that,given an input narrative, uses mechanisms of storytelling to maximize a desired emotional mood within it?" With the tools at my disposal during the development of this project (Yarn, Virtual Tutor, Unity), along with the Emotional Storytelling Approach that was developed, I had to develop a set of experiments that could fully test my proposed hypothesis referenced throughout Chapter 3. For this, I had to verify narratives that not only differed in terms of emotional tone, but also in terms of how intense and detailed were the storytelling approaches used.

4.2 Preliminary Evaluation

In an earlier stage of the development of this project, before having created the post-generation fixes mentioned in Subsection 3.2.3, I developed an experience in order to check whether a distinction in emotions could be verified in the Happy and Dour versions of an input narrative (this one being a longer and more detailed version of the one used in the final experiment).

For this, a small group of 5 subjects watched in succession two videos of the VT system running the two interpretations of the narrative (Happy narrative first, then the Dour one). After this, they answered a small questionnaire. In its first section, they had to answer a set of 18 questions taken from International Personality Item Pool (IPIP) where they evaluated the "OPENNESS TO EXPERIENCE" they may have towards artistic objects [51]; After this, the same list of 15 adjectives inspired in the Hevner's Adjective Circle [31] was presented for each of the two narrative videos they watched (5 positive valence adjectives, 5 negative valence ones, and 5 related to emotional arousal) and, using a Likert scale of 1 to 5, the user had to evaluate the strength with which each adjective (either positive or negative) had within the context of the respective narrative. This questionnaire can be seen in its entirety in Appendix C.

For the Happy narrative, the resulting mean values, standard deviations and medians for posSum and negSum are the following:

- **posSum**: $\overline{x}$ = 12.60, s = 4.037, $\tilde{x}$ = 11;
- **negSum**: $\overline{x}$ = 14.80, s = 2.280, $\tilde{x}$ = 15;

The same corresponding values for the Dour narrative are:

- **posSum**: $\overline{x}$ = 9.00, s = 3.391, $\tilde{x}$ = 7;
- **negSum**: $\overline{x}$ = 15.00, s = 2.550, $\tilde{x}$ = 15;

After checking if the samples followed a normal distribuition with a Shapiro-Wilk test (they did), a T-Student test was run to see if any discernible difference in values between the two narratives could be seen in terms of posSum and negSum values. For posSum, the result of the T-Student was ($T(8)$ = 1.527, p = 0.165), while the result for negSum was ($T(8)$ = -0.131, p = 0.899).

From these results obtained, a very slight discrepancy in the value of paSum between the two narrative types can be discerned, even if no such thing was happening with the negSum values. Due to the small sample size of 5 users, no real conclusions can be taken from this, but this perceived tendency felt like it was enough to warrant a the full experimental procedure that follows.

4.3 Final Experience: Materials

For the experimental process, i had to take into account the manner in which an input narrative is modified in terms of Storytelling in order to produce the most viable evaluative procedure possible. As mentioned in previous Sections 3.2.2 and 3.2.3, first the narrative suffers the removal of Nodes/Sections whose emotional tone is in incongruity with the mood selected by the user, and then visual enhancements are added for later when the narrative is run by the VT system, with the inclusion of emotional expressions, comic-like balloons of text, and dynamic variations in the style of narration according to the choosing of the user (there was no need to specifically test out these sorts of visual animations since these were already tested in the works of Silva and Pereira [47, 48]). So I had to divide these various elements into different groups of tests.

4.3.1 Narratives: Videos & Text

4 different sets of tests and questionnaires were devised (more details on these in the following Section of this document), but the manners in which the narratives are displayed were changed. The 4 different narratives that were used during this experimental phase are the following:

1. Text only version of the narrative with a **Happy** mood (**T+**);
2. Text only version of the narrative with a **Dour** mood (**T-**);
3. Video of the narrative with a **Dour** mood, where the current NPC Storyteller narrator is selected according with to **progression in mood** inside the narrative (**E-**);
4. Video of the narrative with a **Dour** mood, where the NPC Storytellers switch narration on **node to node** basis (**A-**);

Note that the textual versions of the narrative have opposite moods, while the video ones have the same moods with differing approaches when alternating between narrators. This way, we can compare the

two opposing emotional moods in the textual versions and then see if the videos of the VT system, with their added emotional expressions and other details, help out with the emotional output. For this, we only need to test one of the moods, and the chosen one was Dour.

The reason for this choice derives from the research on emotion I did for this work. People have a larger tendency to feel negative emotions in comparison to positive ones. So, I believe that comparing the textual and video versions of a narrative focused negative emotions will most likely lead to more tangible results. These results relate to how well the storytelling tools used in VT can help enhance the overall emotional output. And also, the existence of the textual narratives allows me to form a sort of baseline around the whole experiment.

The base narrative plot that was used as an input (which was written by myself, and whose yarnfile content can be seen in Appendix A) tells the story of a girl named Kali that is hunting a vicious and cruel creature through the dark woods of her land. I sought to include as many moments of peace and hope as moments that had a more intimidating, tense and terrifying tone. This narrative is a condensed version of the one used in the preliminary experiment.

This base narrative has a total of 7 nodes (3 of these are essential, the remaining 4 are non-essential), allowing for enough flexibility while generating the best possible emotional versions of the base narrative. When going through the narrative generation process, my system generates a total of $2^4 = 16$ possible narratives given the base one. From this, it uses the aid of the Emotional Model to select the best one according to the desired emotional mood. The Happy narrative selected by the system has a total of 4 nodes (1 non-essential) and has a TEV of 2.2. On the other hand, the Dour narrative has 5 nodes (2 non-essential) and a TEV of -1.25. The Happy narrative is used for one of the questionnaires (**T+**), while the Dour one is used in the remaining three (**T-**, **E-** and **A-**). The yarnfiles for these two types of narratives are featured in Appendix A.

Then, the Happy narrative and one of the Dour ones were stripped of any indication of narrator, and transcribed as if in literary form, with each node representing a paragraph. The two remaining Dour narratives went through the Post-Generation Fixes of the developed system. First, the narration style chosen by the user at the moment of input is selected (Emotional or Periodical switch of narrators). After this, and independently of the narration style, the appropriate emotional values are introduced in the yarnfile so as to allow the NPC Storytellers to visually emote according to the evolution of mood along the narrative. From these resulting narratives, two videos with a duration of 4m55s were recorded of the VT system running through them.

Next, the document will describe how the questionnaires for each of these narratives was constructed.

4.3.2 Questionnaires

Each questionnaire contains its associated narrative in it, all in order to facilitate the evaluative process for the user. The only differing aspect between them is in their respective narrative, with questions being the same all around. The questionnaires for the textual versions of the narrative have 4 or 5 different sections (depending on whether the narrative is a Happy or Dour one, respectively) reserved solely for the narrative text of their respective yarnfiles; the questionnaires for the video versions of the narrative have that said video directly imbued into a section.

Having explained this, now the rest of the structure of the questionnaires must be explained. The sections of the questionnaire are as follows:

1. The opening section thanks the user for the time that will be spent filling the questionnaire, gives a brief overview on what he/she will be doing and how much time it will take. After this, we ask the user their age and gender;

2. A set of 8 questions is presented in randomized order which allow me to infer how open the user is while engaging with an artistic object (using a Likert scale of 1 to 7, with 1 being “Completely disagree”, and 7 being “Completely agree”). These were taken from the NEO template from IPIP that evaluates the ”Openness to Experience“ from a person [51];

3. A video section/set of text sections containing the narrative related with the questionnaire. The details for this were explained in the beginning of this Subsection;

4. A pair of questions is presented. The first asks the user how intensely he/she perceived ANY kind of emotions during the course of the narrative (Likert scale of 1 to 7, with 1 being “I felt no emotions at all” and 7 being “I felt very intense emotions”). This question was brought from the Arousal section of the questionnaire used by Schaefer et al. [38] (refered in Subsection 2.6.5);

   The second question shows an image taken from the SAM questionnaire [37] mentioned in Subsection 2.6.4. This image relates solely with the Arousal aspect of the emotional evaluation (the bottom half of Fig. 2.10). The image was mirrored and labeled with numbers ranging from 1 to 9 (the reason it was mirrored was for it to allow a left-to-right increase in the values, since the right-to-left would go against the rest of the questionnaire). The user is asked to, according with the image, indicate how intensely they perceived emotions during the course of the narrative (Likert scale of 1 to 9);

5. 16 different groups of adjectives are presented in a random order. The adjectives of each group are similar in meaning and feeling. These vary in terms of valence and arousal. For each of these groups of adjectives, the user must point out how strongly they describe the feelings they felt during the course of the narrative (Likert scale of 1 to 7, with 1 being “Not at all” and 7 being “Very

intensely"). These were brought from the DES section of the questionnaire used by Schaefer et al. [38] (refered in Subsection 2.6.5);

6. 20 different emotions (half being positive, the other half negative) are presented in a random order. The user must describe how these matched the emotions they felt during the course of the narrative (Likert scale of 1 to 5, with 1 being " Very slightly or not at all" and 5 being "Extremely"). These were brought from the PANAS section of the questionnaire used by Schaefer et al. [38] (refered in Subsection 2.6.5);

7. The final section verifies whether the user was in some way not paying attention to the narrative in the questionnaire. For this, it poses a trio of questions regarding details of the narrative they were exposed to.

For a complete look at the questionnaires, see Appendix B.

4.4 Final Experience: Procedure

The four questionnaires were done using Google Forms. The distribution of each of these was done in an informal manner by social-media/email contact with peers from both inside and outside my University. The link for a questionnaire was sent, along with an explicit warning that it would take, at the most, 10 minutes to complete (this was again reinforced in the introductory message of each questionnaire). In the sections that showcased the narrative, be it in video or text form, the viewer was asked to mute the sound of their computers and turn off anything that may distract them from the narrative. At the end of each questionnaire, a thank you note was shown.

The results from the questionnaires were analysed in four major ways. First, **T+** and **T-** were used to compare the differences in emotional valence for two narratives with opposite emotional moods; **E-** and **A-** are compared to check whether the added nuances to the manner in which the NPC Storytellers alternate between themselves while narrating; and finally, **T-** is compared to both **E-** and **A-** to see which of the two storytelling forms was more emotionally effective (text vs video). This makes a total of 4 comparative pairings of narratives.

4.5 Final Experience: Results

A total amount of 48 participants made up the entirety of the Final Experience. All of the gathered data from the 4 questionnaires was analysed and processed through SPSS Statistics (version 25), a software developed by IBM for the statistical analysis of data.

The first subsection describes the demographic data of the participants, while the following will analyse one by one each group of questions mentioned in Subsection 4.3.2. These will not be approached in the order in which they appear on the questionnaires, but rather in terms of possible importance to the derived conclusions.

4.5.1 Demographic Analysis

Each questionnaire was filled out by an equal amount of participants, meaning each questionnaire had a total 12 different results. Each participant could only fill out one type of questionnaire, so as not to add any sort of expectation bias towards a second narrative (study between-subjects).

From the total of 48 participants, a total of 35 classified their gender as Male (72.9%), and 12 said they were of Female gender (25%). The gender of the last remaining participant was agender, which was classified as Other (2.1%). Each questionnaire had a total of 3 female gendered participants, and, except for the **E-** narrative questionnaire, all of them had a total of 9 male gendered participants. The **E-** questionnaire had instead 8 males, and the one existing agendered participant.

The ages of the 48 participants ranged from 18 to 36 years old, with a mean value $\overline{x}$ = 23.83, standard deviation s = 3.899, and median $\tilde{x}$ = 23. The values for age range, mean, standard deviation, and median for each of the questionnaires were the following:

- **T+**: [19 - 27], $\overline{x}$ = 22.67, s = 2.188, $\tilde{x}$ = 22;
- **T-**: [18 - 26], $\overline{x}$ = 22.17, s = 1.889, $\tilde{x}$ = 22.50;
- **E-**: [20 - 29], $\overline{x}$ = 22.83, s = 2.290, $\tilde{x}$ = 22.50;
- **A-**: [21 - 36], $\overline{x}$ = 27.67, s = 5.449, $\tilde{x}$ = 26.50;

As previously mentioned, one of the sections of every questionnaire registered the possible Openness of a participant, with 4 positive openness valued questions and 4 negative openness valued ones. Because the users used a 1-7 Likert scale to answer each question, the manner in which each of their overall Openness value was calculated was, for their respective questionnaire q, the values of all positive questions were added, the values of all negative questions were subtracted, and 32 was then added at the end, all in order not to lose information with the grouping of values relating with negative Openness. The formula is as follows:

$$Openness(q) = pos1(q) + pos2(q) + pos3(q) + pos4(q) - pos5(q) - pos6(q) - pos7(q) - pos8(q) + 32$$

The minimal possible value for this calculation is $min(Openness(q))$ = 8, while the maximum one is $max(Openness(q))$ = 56. Looking then at the results, the Openness values ranged between 33 and

55, with mean value $\overline{x}$ = 46.33, standard deviation s = 5.471, and median $\tilde{x}$ = 46.50. In the article of Costa and McCrae [52], we see that on a scale of 0 to 35, the mean value of the Openness value for Portuguese people $\overline{x} = 18.1$, with a standard deviation $s = 1.058$, which makes it just above the middle point of 15.5. Comparing these values with the ones obtained in my work, I can see my sample has test subjects with a higher-than-average openness to experience.

What this means is that the great majority of the 48 participants are potentially receptive to engage emotionally with pieces of entertainment and/or art.

4.5.2 Emotional Results of the Questionnaires

Before exploring the results, it needs to be noted that the α values used for the computations mentioned during the rest of this subsection were always equal to 0.95.

4.5.2.A Arousal

Before trying to look at the ways in which the emotional valence differs between each of the 4 narratives, the intensity of each of these emotions on a person should be analysed, i.e., the respective emotional arousal.

As it was mentioned in point 4 of Subsection 4.3.2 (check that subsection and Appendix B for more details), each participant registers their self-reported arousal by answering two separate questions, one with a Likert scale of 1 to 7, the other with a Likert scale of 1 to 9.

To check whether these two different questions reported in a similar manner the self-assessed arousal of each user, a Chronbach's Alpha test was run in SPSS between the two. The result was α = 0.849. The common rule for this type of test is if $\alpha >$0.7 for two or more variables being compared, then it means that the variables being compared have a strong correlation in values, as mentioned by Taber [53], for example. This means that there is a strong correlation between the two existing arousal tests I used for my work. Because of this, for the rest of the testing, I only consider the total arousal value, which is the sum of the values of the first and second arousal question.

A T-Student test was used to verify if there were any significant differences between the total arousal values of the narrative pairings mentioned in Section 4.5 (T-Student was chosen because, when testing the normality of the total arousal in regards to each individual narrative type with a Shapiro-Wilk test, all resulting p values were superior to 0.05).

The only relevant result from this T-Student test was when comparing the **T-** and **E-** narratives, where the result was ($T(22)$ = 2.902, p = 0.008). From the high value of T and because $p <$0.05, we can conclude that the average total arousal for the **T-** narrative is significantly higher than the one for **E-**. Checking the means themselves, $\overline{x}$(T-) = 11.58 and $\overline{x}$(E-) = 8.33.

The mean values of arousal per narrative, along with their respective standard deviations were the following:

- **T+**: $\overline{x}$ = 10.08, s = 2.353;
- **T-**: $\overline{x}$ = 11.58, s = 2.275;
- **E-**: $\overline{x}$ = 8.33, s = 3.143;
- **A-**: $\overline{x}$ = 10.00, s = 4.045.

When checking the possible correlations the total arousal value had with the values for Gender, Openness, and Age, no positive results came through.

4.5.2.B PANAS

The PANAS section of each questionnaire was supposed to consist of 10 positive adjectives and 10 negative ones, and an average value was calculated for both halves (paAvg and naAvg). However, due to personal error while building the questionnaire, one of the positive adjectives ended up not being included. This means that, in the version of PANAS used, existed 9 positive adjectives facing the other 10 negative ones. Since however, the values considered are the means and not the sums, the significance of this issue is somewhat diminished, but even then should not be ignored.

Again, a T-Student test was used to check whether the values of paAvg and naAvg differed significantly between the four comparative pairings of narratives (because the Shapiro-Wilk test between concluded that each had a normal distribution, i.e. $p <$0.05).

From this, it was noted that a significant difference in the values of paAvg happened between **T-** and **E-** ($T(22)$ = 2.593, p = 0.017), and also between **T-** and **A-** ($T(22)$ = 2.538, p = 0.019). More specifically, the **T-** narrative had a significantly larger paAvg mean value than its video counterparts. The results of this test for **T+** and **T-** were ($T(22)$ = -0.337, p = 0.739), while for **E-** and **A-** these were ($T(22)$ = -0.169, p = 0.867).

For the values of naAvg, the results of the T-Student test between narratives were ($T(22)$ = 0.691, p = 0.497) for **T+** and **T-**, ($T(22)$ = -1.671, p = 0.109) for **E-** and **A-**, ($T(22)$ = 1.148, p = 0.263) for **T-** and **E-**, and ($T(22)$ = -0.797, p = 0.434) for **T-** and **A-**.

The mean values of paAvg per narrative, along with their respective standard deviations were the following:

- **T+**: $\overline{x}$ = 3.101, s = 0.857;
- **T-**: $\overline{x}$ = 3.222, s = 0.891;

- **E-**: $\overline{x}$ = 2.232, s = 0.978;
- **A-**: $\overline{x}$ = 2.296, s = 0.896.

And the same respective values for naAvg were:

- **T+**: $\overline{x}$ = 2.241, s = 0.743;
- **T-**: $\overline{x}$ = 2.033, s = 0.735;
- **E-**: $\overline{x}$ = 1.733, s = 0.528;
- **A-**: $\overline{x}$ = 2.350, s = 1.164.

If we also consider the fact that, when using the non-parametric Spearman's Correlation test to see if the values of paAvg and naAvg had any sort of correlation with the total arousal value, the results for each were (r_s(48) = 0.601, p = 0.000) and (r_s(48) = 0.551, p = 0.000), respectively. Because the value of p is inferior to 0.05 for each component of PANAS, then we can conclude that a strong positive correlation between PANAS and Arousal exists. So, from what was already gathered in this subsection, it can be seen that video narratives are reporting less successful emotional results than the textual ones.

An already expected result from the experimental phase was that there would be a strong positive correlation between the values of paAvg and naAvg, meaning that a subject who strongly felt positive emotions, would also be sensible to more negative ones. A 2-tailed Spearman's Correlation test verified this hypothesis, with the result of (r_s(48) = 0.430, p = 0.002).

Continuing with the analysis of the results regarding PANAS, using a T-Student test to see if there were differences between genders regarding the values of PANAS, a significant difference in the naAvg values was noticed between the Male and Female genders, with women tending to report higher values for negative adjectives/emotions than their male counterparts ($T(45)$ = 2.227, p = 0.031).

When regarding a possible correlation between PANAS and the Openness value of a subject, a one-tailed analysis of a non-parametric Spearman's Correlation test suggests that the paAvg value of a subject has a slight tendency to increase along with his/her total Openness value (r_s(48) = 0.263, p = 0.036).

No sort of correlation was found regarding PANAS and the age of a subject.

4.5.2.C DES

In the context of this work, the DES component served as a reinforcement of the conclusions reached by the PANAS section of each questionnaire. Since it has 5 groups with positive emotions/adjectives,

and 8 groups with negative ones, the mean values for each of these major groups (desPosAvg and desNegAvg) were used for most of this part of the statistical analysis.

With the Shapiro-Wilk test reporting that the four narrative types and the two aforementioned mean values for DES follow normal distributions, a T-Student test was run for the 4 relevant narrative pairings. A significant difference in mean values of desPosAvg was found between the **T-** and **E-** narratives ($T(22)$ = 2.145, p = 0.043).

The mean values of desPosAvg per narrative, along with their respective standard deviations were the following:

- **T+**: $\overline{x}$ = 2.887, s = 1.327;
- **T-**: $\overline{x}$ = 2.867, s = 1.035;
- **E-**: $\overline{x}$ = 2.000, s = 0.942;
- **A-**: $\overline{x}$ = 2.300, s = 1.149.

And the same respective values for desNegAvg were:

- **T+**: $\overline{x}$ = 2.708, s = 0.798;
- **T-**: $\overline{x}$ = 2.479, s = 0.907;
- **E-**: $\overline{x}$ = 2.041, s = 0.782;
- **A-**: $\overline{x}$ = 2.667, s = 1.397.

Taking a look at how the results for each of the specific groups of adjectives that constitute DES differ between narrative pairings, using a Mann-Whitney U test because not all variables follow a normal distribution, we notice a few more differences between all 4 narrative pairings.

For the negative group of adjectives *(Sad, downhearted, blue)*, **T+** and **T-** have a significant difference (U = 37.5, p = 0.037), with **T+** surprisingly showcasing a significantly larger Mean Rank (15.38) than the one for **T-** (9.63). This is most likely due to a conflict between the inner tone of the narrative and the objective tagging of the yarnfile, which classified sections that were more Dour as being Happy, which made the **T+** an emotionally heavier narrative than anticipated.

A- showcases significantly higher Mean Ranks (13.25, 14.67) for the the negative adjective groups of *(Guilty, remorseful)*, and *(Ashamed, embarrassed)*, when compared with **E-** (10.00, 10.33). The respective Mann-Whitney U results are (U = 42, p = 0.015) and (U = 46, p = 0.048). This helps us infer that a few negative emotions are more strongly felt when the style in which the narrators alternate between themselves is more simple and periodic.

The **T-** and **E-** narratives differed in three separate groups of emotions, with the former having consistently better results than the latter. For *(Interested, concentrated, alert)*, which is specifically targets the arousal of a subject, a significant difference between the narratives was detected (U = 36, p = 0.034), with **T-** having a superior Mean Rank (15.5) to the one of **E-** (9.5). For *(Surprised, amazed, astonished)*, another one regarding arousal, the Mann-Whitney U test has a result of (U = 38, p = 0.044), with Mean Ranks (15.33) for **T-** and (9.67) for **E-**. *(Satisfied, pleased)* saw also a significant difference between narratives (U = 35.5, p = 9.46), with the Mean Rank values for **T+** and **E-** being 15.54 and 9.46, respectively. All of this reinforces the already existing idea that the video approach to the narratives using the VT system result in emotional results that are less intense in both arousal and valence.

This is something that is further reinforced by one of the results obtained when comparing **T-** with **A-**. Again, the results regarding group of emotions *(Surprised, amazed, astonished)* suffer a significant difference between these narratives (U = 36, p = 0.034), with **T-** again having a larger Mean Rank (15.5) than its video counterpart (9.5). However, the only time a video narrative managed to have a superior result to its textual counterpart occurs here. For the emotion group *(Guilty, remorseful)* (U = 46, p = 0.048), where **T-** has an inferior Mean Rank (10.33) compared to the one of **A-** (14.67). Still, this does not deny the larger existing pattern of negative results seen in video narratives.

Returning again to the desPosAvg and desNegAvg values, it was seen that these have a strong positive correlation with the paAvg and naAvg values from PANAS. All of the four possible comparisons between these values, done with a Spearman's Correlation test (both 1-Tailed and 2-Tailed), resulted in p values equal or inferior to 0.02, which in itself is inferior to 0.05. What this means is that the results obtained by both tests complement each other. For desPosAvg, the exact results for the Spearman test with paAvg were (r_s(48) = 0.706, $p_{1-tailed}$ = 0.000, $p_{2-tailed}$ = 0.000), and with naAvg were (r_s(48) = 0.399, $p_{1-tailed}$ = 0.002, $p_{2-tailed}$ = 0.005). For desNegAvg, the corresponding results were of (r_s(48) = 0.336, $p_{1-tailed}$ = 0.02, $p_{2-tailed}$ = 0.01) for paAvg, and (r_s(48) = 0.795, $p_{1-tailed}$ = 0.000, $p_{2-tailed}$ = 0.000) for naAvg.

DES also has a very strong positive correlation with the total values for arousal. All possible variations of a Spearman's Correlation test were run, and the results always had p = 0.000. Again, these two tests complement the results from one another. For desPosAvg, the exact results of the Spearman's Correlation test with the arousal parameter were (r_s(48) = 0.505, $p_{1-tailed}$ = 0.000, $p_{2-tailed}$ = 0.000), and the respective results for desNegAvg were (r_s(48) = 0.570, $p_{1-tailed}$ = 0.000, $p_{2-tailed}$ = 0.000)

As in similar fashion with PANAS, DES presents a direct positive correlation in its desPosAvg and desNegAvg values, with a Two-tailed Spearman's Correlation test resulting in (r_s(48) = 0.368, p = 0.010).

The positive mean for DES also, similarly as with paAvg value of PANAS, presents a direct positive

correlation with the Openness value, with a Spearman's Correlation test resulting in (r_s(48) = 0.368, p = 0.010). From this, one can infer that the Openness of a subject may have influence on how strongly he/she perceives and responds to positive emotional stimuli.

A surprising result was seen when relating DES with the age of a subject. A negative strong correlation was detected between the value of desPosAvg and age (r_s(48) = -0.401, p = 0.005), meaning that younger subjects have a larger tendency to feel and respond to positive emotional stimuli.

When trying to see if there was a correlation between DES and the gender of a subject, no correlation was detected.

4.5.2.D Verification Questions

The three verification questions regarding narrative presented a surprising set of results. The validation score for each test subject varies between 0 (all answers wrong) and 3 (all answers right). The values for mean and standard deviation for each of the four narratives is as follows:

- **T+**: $\overline{x}$ = 3, s = 0;
- **T-**: $\overline{x}$ = 3, s = 0;
- **E-**: $\overline{x}$ = 2.58, s = 0.793;
- **A-**: $\overline{x}$ = 2.58, s = 0.504.

The respective Mean Rank values for **T+**, **T-**, **E-** and **A-** Are 28.5, 28.5, 22.08, and 18.92, further validating the conclusion mentioned in the previous paragraph.

As can be seen, the video narratives were the only ones where participants failed one or more verification questions. When running a Kruskal-Wallis H test to check whether some significant difference existed between mean values for **T+**, **T-**, **T+** and **A-**. The results were ($\chi^2(3) = 10.073, p = 0.018$), which means that some significant difference exists between these 4 values.

A Mann-Whitney U test across all pairs of results (with an $\alpha = 0.05/4 = 0.013$) resulted in a significant difference existing between the results of **T+** and **A-**, and also **T-** and **A-**, with the result being (U = 42, p = 0.014). This p value, together with the mean rank values, we can see that the verification results for **A-** were much less favorable than the ones for both text narratives. With **E-**, no conclusive difference can be seen, since the result of comparing it with the text narratives was (U = 54, p = 0.070). No difference is noted between **E-** and **A-** (U = 65, p = 0.626).

4.6 Discussion

4.6.1 T+ vs T-

From the results gathered, we saw that no substantial difference in the perception of emotional moods occurred when contrasting the results of the **T+** narrative with the ones from the **T-**. All of the T-Student tests done across the Arousal, DES and PANAS components showed that no strong difference between the two narratives existed.

Looking more closely, if we check the mean values gathered along the three main components of the questionnaire, what we see is that sometimes there is a very slight inversion in the results that were expected. What this means is sometimes users of the **T+** narrative felt negative emotions with slightly more intensity than the users of **T-**, and the **T-** users felt positive emotions with more intensity than the ones from **T+**. However, the T-Student never pointed these differences as being of a significant variety.

4.6.2 E- vs A-

There was no significant difference in the results obtained by comparing detected between **E-** and **A-**. Results for the former were slightly less positive than for the latter, but not in any way conclusive.

4.6.3 T- vs E-

Now, regarding the results from the comparisons between the narratives **T-** and **E-**, a subversion of the expected results is fully evidenced. The **E-** narrative was the one that, according to the expectations for this work, would generate a stronger intensity in terms of negative (Dour) emotions, meaning greater values regarding negative valence emotions and a higher arousal than the other two narratives.

However, the exact opposite happened, with the **E-** narrative being the uncontested “loser” of this series of experiments, with its results being consistently worse compared to **T-**. The result ($T(22) = 2.902$, $p = 0.008$) that comes from the T-Student test that compared the mean values of arousal between these two could be a strong indication of this.

4.6.4 T- vs A-

There was no significant difference detected between **T-** and **A-**, but a close analysis of the results shows that the ones regarding the latter tended to be slightly less favorable than for the former. But again, these are not strong enough to be considered conclusive.

4.6.5 Others

One unexpected result that came from these experiments was that, for two video narratives, users sometimes failed the verification questions at the end of their questionnaires. The results specifically state that this is the case with the **A-** narrative in particular..

The Openness of a test subject only had a noticeable influence in the manner with which he/she perceived positive emotions.

Gender affected the manner with which negative emotions were perceived, specifically with Female subjects, who were prone to feel these types of emotions more intensely.

Lastly, age had a negative impact in the perception of positive emotions of the DES section of the questionnaire, with a noticeable decrease in their intensity being reported by older subjects.

5

Conclusions

Contents

The main issue that gave rise to the work described in this document was the growing manner in which PCG was being used to generate the plots of narratives, which ended up neglecting the manner in which these narratives were told, i.e. their storytelling approach.

To best prepare for this challenge, a two-part research process was conducted during the development of the project. Some of the essential ideas behind the construction of written narratives, the many elements that constitute interactive virtual stories, and computer models that helped construct storytelling-focused virtual narratives, these elements went into the construction of the narrative generation system, along with the writing of the plot for the narrative. Then, some research was made in the field of emotions regarding video games and interactive stories, which not only helped build some emotional nuance into the written narrative, but also, together with the exploration of various forms of emotional evaluation towards artistic objects, assisted the construction of evaluation approach used in the experimental phase of this work.

Using the Virtual Tutor system along with the Yarn tool, I developed a system that received as input properly tagged and labeled narratives that were then processed according with choices the user of the system made, resulting in narratives that tried to maximize one of two emotional moods (Happy or Dour), that sought as well to maximize the intensity of the emotions they brought on a spectator. This system supported itself on an emotional model that was built from the ground up to support the ideas and objectives of this work. It uses the manner in which the writer marked the variation in objectives of the main character(s) of a narrative, and infered a progression for its respective emotional mood. This results in narratives that have parts of them removed, and are filled out with specific commands so that, when it reaches the output VT system, the emotional impact of the narrative can be aligned with the chosen mood. These commands changed the manner in which the two virtual characters (NPC Storytellers) from VT expressed emotions and alternated between themselves when telling the narrative to a spectator.

To test this idea, four different versions of the same input narrative were created. The first was formatted in textual form, and with a Happy mood; the second also was purely text, but with a Dour mood; the third, was a video recording of VT running the already mentioned Dour narrative, and had the NPC Storytellers switching the narration between themselves according with the progression in mood of the narrative; the fourth one was exactly the same as the third, except that the narrators alternated between themselves in a periodical node-to-node manner.

Unfortunately, the results were inconclusive regarding the effective distinction in emotional moods towards a base narrative, and showcased that narratives run in the VT system had a lesser emotional impact on subjects. But despite this, it was shown that the manner in which a narrative is told can directly influence the intensity of the emotions it is liable to trigger. The expectation was that the **E-** narrative, the one with the more sophisticated array of storytelling elements would be the one with the best emotional

results. In the end, the total opposite occurred, and it was the **T-** narrative, the most simple of the Dour narratives, that showcased the most favorable results. The manner in which a narrative is told can indeed enhance its emotional results, but could also do the total opposite and diminish its overall impact, both in terms of arousal and valence. This supported the second of my hypotheses, albeit in a manner that subverted the existing expectations.

Note that this conclusion applies to a sample of test subjects whose “Openness to Experience” is considered above-average, a group of people one could assume would be more receptive to this sort of artistic media.

5.1 Future Work

Regarding the unexpected results achieved in the course of this work, I find it would be necessary to pinpoint which of the many parts of the system hurt the results of the Emotional Model. To solve this, a few possible solutions could be explored.

One could potentially improve upon the manner in which the many animations and visual elements Virtual Tutor, or simply replace it by a system with a more ”cartoony” aspect. The faces of the two characters in the system, while they do look mostly realistic, are animated in an unrealistic manner, which may convey an ”uncanny valley” effect to them. A potential result from this is a breaking of immersion on the part of the viewer that would be less likely if they were purposefully less realistic.

Together with this, the addition of a system that dynamically played and switched between certain sets of music. This would complement the ongoing narratives, and would help bring a greater sense of emotional resonance to them.

Looking now at the developed emotional model itself, the manner in which it takes into account the progression of mood in the narrative could also see some refinement. At this moment, it uses a simple approach of checking the last three changes in objectives in order to evaluate the moment-to-moment emotional mood. Adding some sort of contextual dynamism to this could help emphasize some key emotional moments, and would help bring more nuance to the storytelling. For this, a refinement in the tagging process of the yarnfiles would also need to be done.

Lastly, the manners in which the input narrative is manipulated could be further developed. In my work, the only thing that happens is the omission of nodes/sections of the narrative. So, more storytelling options could be added, such as shuffling the order of the narrative, the addition of narrative techniques such as Foreshadowing and *In Media Res*, creating more enticing narrative options for the writer.

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A

Narratives

Listing A.1: Input yarnfile narrative for final experiment

```
title: CampfireNight.Part1
tags: 1 | isEssential:False
colorID: 1
position: 238,236
---
<<OBJECTIVE:0.0; Calm:0.0>>
Joao: The sky, completely stripped of clouds, flourished with glistening stars.
Joao: Every conceivable constellation was there for the eye to see.
Joao: The S shape of the Old Drake;
Joao: The broken arch of Glundun's Lyre;
Joao: The confused, mishmash pattern of dots that made the Fire Bull;
Maria: Kali watched them all from her little improvised camp,
Maria: right beneath a clearing in the low treetops of Salazar's Woods.
```

```
<<OBJECTIVE:0.0; Calm:0.1>>
Maria: She found herself happily grinning upwards,
Maria: remembering the final days she spent in her village before coming here.
<<OBJECTIVE:0.0; Calm:0.1>>
Maria: Then, with a stronger arm than before,
Maria: she proceeded with the sharpening of the blade.

[[>|CampfireNight.Part2]]
[[Repeat|CampfireNight.Part1]]
===
title: CampfireNight.Part2
tags: 2 | isEssential:False
colorID: 1
position: 503,237
---
Joao: This would be her first solitary venture into the wilds.
Joao: Ganji, her master, insisted that she should do this by herself.
<<OBJECTIVE:0.2; Calm:0.5>>
Maria: "You're much too experienced to have this bag of old meat protecting you,"
Maria: was the last thing he said to her before she departed,
Maria: and then he gifted her with his sword Sear,
Maria: named for the simmering heat its blade generated when swung or thrusted.
<<OBJECTIVE:0.2; Calm:0.7>>
Joao: Tomorrow, Kali would hopefully put it to good use.
Joao: She had been following Its trail for more than a day now.
Joao: Sooner or later, it would end.
Maria: When she was done with the blade, she carefully placed it in its sheath,
Maria: and layed on her makeshift mattress of leaves and moss, using her pack as a pillow.
Maria: "Tomorrow..." she remembered saying to herself as she fell asleep,
<<OBJECTIVE:0.2; Calm:0.8>>
Maria: "tomorrow, you're dead."

[[>|CaveNoon.Part1]]
[[Repeat|CampfireNight.Part2]]
===
title: CaveNoon.Part1
tags: 3 | isEssential:False
colorID: 5
```

```
position: 235,521
---
<<OBJECTIVE:-0.5; Calm:-0.6>>
Maria: The blood trail she was following led to an enormous cave.
Maria: It's entrance, a wide-open mouth of dark gloom ripping out of the body of the hill's wa
Maria: broken and sharp stalactite and stalagmite fangs in wait of any entering prey.
Joao: Grabbing a broken oak branch from the surrounding treeline, she took a bundle of dead le
Joao: wrapped them around one of the branch's ends with some linen cloth soaked in old licor a
Joao: after unbuckling Sear, her blade, from its sheath, she waved it for a few seconds in the
Joao: and pressed the scalding blade on the wet cloth.
<<OBJECTIVE:0.0; Calm:0.0>>
Joao: It caught fire instantly.
Maria: Now, the moment she feared, the moment she eagerly waited for, was at hand.
Maria: Up-and-down shivers needled the skin of her back and neck.
Maria: Sweat filled the inside of her trembling leather gloves.
<<OBJECTIVE:-0.2; Calm:-0.3>>
Maria: Taking three deep breaths and a short prayer, she stepped into the darkness.

[[>|CaveNoon.Part2]]
[[Repeat|CaveNoon.Part1]]
===
title: CaveNoon.Part2
tags: 4 | isEssential:True
colorID: 5
position: 485,514
---
<<OBJECTIVE:0.1; Calm:-0.6>>
Maria: The torch's light was enough for her to get her immediate bearings inside the cave,
Maria: but it also blinded Kali's eyes to the void outside the ring of light,
Maria: which, at times, seemed almost alive with shifting thought and tentacle motion.
Joao: Some years before, with Genji still carefully watching over her,
Joao: they hunted a highly vicious nightcrawler that hid himself in a cave not unlike this one
Joao: They knew what it was capable of, having seen some of the gore it left in its wake.
Joao: But they caught and killed it. The dark couldn't protect him from Sear.
Joao: In the village, they were received with tremendous celebration and rejoice.
Joao: They even brought out some of the leftover fireworks from New Year's Celebration,
Joao: and fired them up into the stars.
Joao: That was one of the happiest nights of Kali's life.
```

```
<<OBJECTIVE:0.1; Calm:0.0>>
Maria: Kali smiled at the thought,
Maria: and the looming darkness felt like it had lost some of its initial weight on her.
Maria: She walked on, blood trail still underneath her heels.

[[>|CaveNoon.Part3]]
[[Repeat|CaveNoon.Part2]]
===
title: CaveNoon.Part3
tags: 5 | isEssential:True
colorID: 5
position: 758,513
---
Maria: She came to a point where the cave became slightly wider, and the ceiling much taller,
Maria: so much so, that the light of her torch couldn't even reach it.
<<OBJECTIVE:0.3; Calm:-0.1>>
Joao: As her chest tightened, she drew Sear.
Joao: Any sign of shifting movement, any slight noise at the edge of earing,
Joao: any whiff of decayed flesh, any pair of eyes glowing in the midst of the gloom,
Joao: her senses and muscles were ready to respond accordingly.
<<OBJECTIVE:0.3; Calm:-0.3>>
Maria: The trail ended abruptly.
Maria: As if in one moment the blood was steadily falling to the ground,
Maria: and in another it had suddenly been cut off.
<<OBJECTIVE:0.3; Calm:-0.7>>
Maria: A deep, guttural snarl, almost mocking in tone, came from behind her.
Maria: And when she turned around, she saw Its two slitted yellow eyes,
Maria: both screaming silently for her blood and flesh.
Joao: She wasn't surprised.

[[>|CaveNoon.Part4]]
[[Repeat|CaveNoon.Part3]]
===
title: CaveNoon.Part4
tags: 6| isEssential:False
colorID: 5
position: 1031,512
---
```

```
Joao: She ran towards the Creature, swinging the blade Sear ahead of her,
Joao: and thrusted the blade into It, but the Thing swiftly dodged her attack,
Joao: and, with Its huge, bloated left arm, pounded her to the ground.
<<OBJECTIVE:-0.2; Calm:-0.5>>
Joao: Kali, all air suddenly rushing out of her chest, felt like she was hit by a battering ra
Maria: As she regained her breath, she couldn't help but smell It.
<<OBJECTIVE:-0.3; Calm:-0.7>>
Maria: A nauseous reek, a mix of rotten flesh, bile and sulfur.
Maria: Sear still in hand, she picked up the dropped torch, its light weaker than before.
Maria: But that was enough for Kali to catch a glimpse of Its crimson filled, hairy snout,
Maria: rows of brownish, sharp teeth adorning a hungry, devilish grin.
<<OBJECTIVE:-0.5; Calm:-1.0>>
Joao: It jumped on her, swinging its arms and legs - dagger like claws in each - left and righ
Joao: with Kali managing to dodge most of the incoming charge, but each time her blood was she
Joao: the horror, the fear inside her mind, spread further through her limbs.
Joao: And it was if the Thing felt revitalized, coming at her with ever increasing ferocity.

[[>|CaveNoon.Part5]]
[[Repeat|CaveNoon.Part4]]
===
title: CaveNoon.Part5
tags: 7 | isEssential:True
colorID: 5
position: 1031,512
---
Maria: Kali couldn't say if this rush of attacks had lasted 2 minutes or 2 hours.
<<OBJECTIVE:0.0; Calm:-0.9>>
Maria: When It stopped, Kali had the the entirety of her coat and trousers ripped and bloodied
Maria: Her left shoulder was dislocated, so she couldn't move the arm dangling underneath it.
Maria: Sear was still in her right hand, though. The torch she held in her teeth.
Maria: But she knew her body couldn't take much more of this.
<<OBJECTIVE:0.5; Calm:0.0>>
Joao: "Last chance," she thought to herself.
Joao: And with all of her remaining strength and will pulling for her body, she charged at It.
Joao: Responding in tandem, It also charged at her in a bestial, galloping motion.
<<OBJECTIVE:0.0; Calm:0.0>>
Joao: It was now or never.
Joao: "Do or die".
```

```
166
167 <<exit>>
168 ===
```

Listing A.2: Happy Narrative resulting from the input narrative above

```
1  title: CampfireNight.Part2
2  tags: 2 | isEssential:False
3  colorID: 1
4  position: 503,237
5  ---
6  <<wait 1>>
7  <<OverrideTextEffects Sadness 1 showEffects None linearCurve hideEffects None linearCurve>>
8  <<wait 1>>
9  Maria: This would be her first solitary venture into the wilds.
10 Maria: Ganji, her master, insisted that she should do this by herself.
11 <<Feel Maria Neutral 0.8 None>>
12 <<Feel Maria Happiness 0.2 None>>
13 <<Feel Joao Neutral 0.5 None>>
14 <<OBJECTIVE:0.2; Calm:0.5>>
15 Maria: "You're much too experienced to have this bag of old meat protecting you,"
16 Maria: was the last thing he said to her before she departed,
17 Maria: and then he gifted her with his sword Sear,
18 Maria: named for the simmering heat its blade generated when swung or thrusted.
19 <<Feel Maria Neutral 0.8 None>>
20 <<Feel Maria Happiness 0.5 None>>
21 <<Feel Joao Neutral 0.8 None>>
22 <<Feel Joao Surprise 0.3 None>>
23 <<OBJECTIVE:0.2; Calm:0.7>>
24 <<Nod Joao Start>>
25 Maria: Tomorrow, Kali would hopefully put it to good use.
26 Maria: She had been following Its trail for more than a day now.
27 <<Nod Joao Stop>>
28 Maria: Sooner or later, it would end.
29 Maria: When she was done with the blade, she carefully placed it in its sheath,
30 Maria: and layed on her makeshift mattress of leaves and moss, using her pack as a pillow.
31 Maria: "Tomorrow..." she remembered saying to herself as she fell asleep,
32 <<Feel Maria Neutral 0.8 None>>
```

```
<<Feel Maria Happiness 0.2 None>>
<<Feel Joao Neutral 0.5 None>>
<<OBJECTIVE:0.2; Calm:0.8>>
<<Nod Maria Start>>
Joao: "tomorrow, you're dead."
<<Nod Maria Stop>>

[[>|CaveNoon.Part2]]
[[Repeat|CampfireNight.Part2]]
===
title: CaveNoon.Part2
tags: 4 | isEssential:True
colorID: 5
position: 485,514
---
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Sadness 0.2 None>>
<<Feel Joao Neutral 0.5 None>>
<<OBJECTIVE:0.1; Calm:-0.6>>
Joao: The torch's light was enough for her to get her immediate bearings inside the cave,
Joao: but it also blinded Kali's eyes to the void outside the ring of light,
<<Nod Maria Start>>
Joao: which, at times, seemed almost alive with shifting thought and tentacle motion.
Joao: Some years before, with Genji still carefully watching over her,
<<Nod Maria Stop>>
Joao: they hunted a highly vicious nightcrawler that hid himself in a cave not unlike this one
Joao: They knew what it was capable of, having seen some of the gore it left in its wake.
Joao: But they caught and killed it. The dark couldn't protect him from Sear.
Joao: In the village, they were received with tremendous celebration and rejoice.
Joao: They even brought out some of the leftover fireworks from New Year's Celebration,
<<Nod Maria Start>>
Joao: and fired them up into the stars.
Joao: That was one of the happiest nights of Kali's life.
<<Nod Maria Stop>>
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Happiness 1.0 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Surprise 1.0 None>>
```

```
<<OBJECTIVE:0.1; Calm:0.0>>
Maria: Kali smiled at the thought,
<<Nod Joao Start>>
Maria: and the looming darkness felt like it had lost some of its initial weight on her.
Maria: She walked on, blood trail still underneath her heels.
<<Nod Joao Stop>>

[[>|CaveNoon.Part3]]
[[Repeat|CaveNoon.Part2]]
===
title: CaveNoon.Part3
tags: 5 | isEssential:True
colorID: 5
position: 758,513
---
Maria: She came to a point where the cave became slightly wider, and the ceiling much taller,
<<Nod Joao Start>>
Maria: so much so, that the light of her torch couldn't even reach it.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Happiness 0.5 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Surprise 0.3 None>>
<<OBJECTIVE:0.3; Calm:-0.1>>
Joao: As her chest tightened, she drew Sear.
<<Nod Joao Stop>>
Joao: Any sign of shifting movement, any slight noise at the edge of earing,
Joao: any whiff of decayed flesh, any pair of eyes glowing in the midst of the gloom,
Joao: her senses and muscles were ready to respond accordingly.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Happiness 0.2 None>>
<<Feel Joao Neutral 0.5 None>>
<<OBJECTIVE:0.3; Calm:-0.3>>
Joao: The trail ended abruptly.
Joao: As if in one moment the blood was steadily falling to the ground,
<<Nod Maria Start>>
Joao: and in another it had suddenly been cut off.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Sadness 0.2 None>>
```

```
<<Feel Joao Neutral 0.5 None>>
<<OBJECTIVE:0.3; Calm:-0.7>>
Joao: A deep, guttural snarl, almost mocking in tone, came from behind her.
<<Nod Maria Stop>>
Joao: And when she turned around, she saw Its two slitted yellow eyes,
Joao: both screaming silently for her blood and flesh.
Joao: She wasn't surprised.

[[>|CaveNoon.Part5]]
[[Repeat|CaveNoon.Part3]]
===
title: CaveNoon.Part5
tags: 7 | isEssential:True
colorID: 5
position: 1031,512
---
Joao: Kali couldn't say if this rush of attacks had lasted 2 minutes or 2 hours.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Sadness 0.5 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Fear 0.3 None>>
<<OBJECTIVE:0.0; Calm:-0.9>>
<<Nod Maria Start>>
Joao: When It stopped, Kali had the the entirety of her coat and trousers ripped and bloodied.
Joao: Her left shoulder was dislocated, so she couldn't move the arm dangling underneath it.
<<Nod Maria Stop>>
Joao: Sear was still in her right hand, though. The torch she held in her teeth.
Joao: But she knew her body couldn't take much more of this.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Happiness 1.0 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Surprise 1.0 None>>
<<OBJECTIVE:0.5; Calm:0.0>>
Maria: "Last chance," she thought to herself.
Maria: And with all of her remaining strength and will pulling for her body, she charged at It
Maria: Responding in tandem, It also charged at her in a bestial, galloping motion.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Sadness 1.0 None>>
```

```
147 <<Feel Joao Neutral 0.8 None>>
148 <<Feel Joao Fear 1.0 None>>
149 <<OBJECTIVE:0.0; Calm:0.0>>
150 <<Nod Maria Start>>
151 Joao: It was now or never.
152 Joao: "Do or die".
153 <<Nod Maria Stop>>
154
155 <<exit>>
156 ===
```

Listing A.3: Dour Narrative resulting from the input Narrative above

```
1  title: CaveNoon.Part1
2  tags: 3 | isEssential:False
3  colorID: 5
4  position: 235,521
5  ---
6  <<wait 1>>
7  <<OverrideTextEffects Sadness 1 showEffects None linearCurve hideEffects None linearCurve>>
8  <<wait 1>>
9  <<Feel Maria Neutral 0.8 None>>
10 <<Feel Maria Sadness 0.2 None>>
11 <<Feel Joao Neutral 0.5 None>>
12 <<OBJECTIVE:-0.5; Calm:-0.6>>
13 Joao: The blood trail she was following led to an enormous cave.
14 Joao: It's entrance, a wide-open mouth of dark gloom ripping out of the body of the hill's wal
15 Joao: broken and sharp stalactite and stalagmite fangs in wait of any entering prey.
16 Joao: Grabbing a broken oak branch from the surrounding treeline, she took a bundle of dead le
17 Joao: wrapped them around one of the branch's ends with some linen cloth soaked in old licor a
18 Joao: after unbuckling Sear, her blade, from its sheath, she waved it for a few seconds in the
19 <<Nod Maria Start>>
20 Joao: and pressed the scalding blade on the wet cloth.
21 <<Feel Maria Neutral 0.8 None>>
22 <<Feel Maria Happiness 1.0 None>>
23 <<Feel Joao Neutral 0.8 None>>
24 <<Feel Joao Surprise 1.0 None>>
25 <<OBJECTIVE:0.0; Calm:0.0>>
```

```
Maria: It caught fire instantly.
<<Nod Maria Stop>>
Maria: Now, the moment she feared, the moment she eagerly waited for, was at hand.
Maria: Up-and-down shivers needled the skin of her back and neck.
Maria: Sweat filled the inside of her trembling leather gloves.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Sadness 1.0 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Fear 1.0 None>>
<<OBJECTIVE:-0.2; Calm:-0.3>>
<<Nod Maria Start>>
Joao: Taking three deep breaths and a short prayer, she stepped into the darkness.
<<Nod Maria Stop>>

[[>|CaveNoon.Part2]]
[[Repeat|CaveNoon.Part1]]
===
title: CaveNoon.Part2
tags: 4 | isEssential:True
colorID: 5
position: 485,514
---
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Happiness 1.0 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Surprise 1.0 None>>
<<OBJECTIVE:0.1; Calm:-0.6>>
Maria: The torch's light was enough for her to get her immediate bearings inside the cave,
Maria: but it also blinded Kali's eyes to the void outside the ring of light,
Maria: which, at times, seemed almost alive with shifting thought and tentacle motion.
<<Nod Joao Start>>
Maria: Some years before, with Genji still carefully watching over her,
Maria: they hunted a highly vicious nightcrawler that hid himself in a cave not unlike this on
<<Nod Joao Stop>>
Maria: They knew what it was capable of, having seen some of the gore it left in its wake.
Maria: But they caught and killed it. The dark couldn't protect him from Sear.
Maria: In the village, they were received with tremendous celebration and rejoice.
Maria: They even brought out some of the leftover fireworks from New Year's Celebration,
```

```
Maria: and fired them up into the stars.
Maria: That was one of the happiest nights of Kali's life.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Happiness 0.5 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Surprise 0.3 None>>
<<OBJECTIVE:0.1; Calm:0.0>>
<<Nod Joao Start>>
Maria: Kali smiled at the thought,
Maria: and the looming darkness felt like it had lost some of its initial weight on her.
<<Nod Joao Stop>>
Maria: She walked on, blood trail still underneath her heels.

[[>|CaveNoon.Part3]]
[[Repeat|CaveNoon.Part2]]
===
title: CaveNoon.Part3
tags: 5 | isEssential:True
colorID: 5
position: 758,513
---
Maria: She came to a point where the cave became slightly wider, and the ceiling much taller,
Maria: so much so, that the light of her torch couldn't even reach it.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Happiness 0.5 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Surprise 0.3 None>>
<<OBJECTIVE:0.3; Calm:-0.1>>
<<Nod Joao Start>>
Maria: As her chest tightened, she drew Sear.
Maria: Any sign of shifting movement, any slight noise at the edge of earing,
<<Nod Joao Stop>>
Maria: any whiff of decayed flesh, any pair of eyes glowing in the midst of the gloom,
Maria: her senses and muscles were ready to respond accordingly.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Happiness 0.2 None>>
<<Feel Joao Neutral 0.5 None>>
<<OBJECTIVE:0.3; Calm:-0.3>>
```

```
Joao: The trail ended abruptly.
Joao: As if in one moment the blood was steadily falling to the ground,
Joao: and in another it had suddenly been cut off.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Sadness 0.2 None>>
<<Feel Joao Neutral 0.5 None>>
<<OBJECTIVE:0.3; Calm:-0.7>>
<<Nod Maria Start>>
Joao: A deep, guttural snarl, almost mocking in tone, came from behind her.
Joao: And when she turned around, she saw Its two slitted yellow eyes,
<<Nod Maria Stop>>
Joao: both screaming silently for her blood and flesh.
Joao: She wasn't surprised.

[[>|CaveNoon.Part4]]
[[Repeat|CaveNoon.Part3]]
===
title: CaveNoon.Part4
tags: 6| isEssential:False
colorID: 5
position: 1031,512
---
Joao: She ran towards the Creature, swinging the blade Sear ahead of her,
Joao: and thrusted the blade into It, but the Thing swiftly dodged her attack,
<<Nod Maria Start>>
Joao: and, with Its huge, bloated left arm, pounded her to the ground.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Sadness 0.5 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Fear 0.3 None>>
<<OBJECTIVE:-0.2; Calm:-0.5>>
Joao: Kali, all air suddenly rushing out of her chest, felt like she was hit by a battering ra
<<Nod Maria Stop>>
Joao: As she regained her breath, she couldn't help but smell It.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Sadness 0.5 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Fear 0.3 None>>
```

```
<<OBJECTIVE:-0.3; Calm:-0.7>>
Joao: A nauseous reek, a mix of rotten flesh, bile and sulfur.
Joao: Sear still in hand, she picked up the dropped torch, its light weaker than before.
Joao: But that was enough for Kali to catch a glimpse of Its crimson filled, hairy snout,
Joao: rows of brownish, sharp teeth adorning a hungry, devilish grin.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Sadness 0.5 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Fear 0.3 None>>
<<OBJECTIVE:-0.5; Calm:-1.0>>
Joao: It jumped on her, swinging its arms and legs - dagger like claws in each - left and righ
<<Nod Maria Start>>
Joao: with Kali managing to dodge most of the incoming charge, but each time her blood was she
Joao: the horror, the fear inside her mind, spread further through her limbs.
<<Nod Maria Stop>>
Joao: And it was if the Thing felt revitalized, coming at her with ever increasing ferocity.

[[>|CaveNoon.Part5]]
[[Repeat|CaveNoon.Part4]]
===
title: CaveNoon.Part5
tags: 7 | isEssential:True
colorID: 5
position: 1031,512
---
Joao: Kali couldn't say if this rush of attacks had lasted 2 minutes or 2 hours.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Happiness 1.0 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Surprise 1.0 None>>
<<OBJECTIVE:0.0; Calm:-0.9>>
Maria: When It stopped, Kali had the the entirety of her coat and trousers ripped and bloodied
<<Nod Joao Start>>
Maria: Her left shoulder was dislocated, so she couldn't move the arm dangling underneath it.
Maria: Sear was still in her right hand, though. The torch she held in her teeth.
<<Nod Joao Stop>>
Maria: But she knew her body couldn't take much more of this.
<<Feel Maria Neutral 0.8 None>>
```

```
<<Feel Maria Happiness 0.5 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Surprise 0.3 None>>
<<OBJECTIVE:0.5; Calm:0.0>>
Maria: "Last chance," she thought to herself.
Maria: And with all of her remaining strength and will pulling for her body, she charged at It
Maria: Responding in tandem, It also charged at her in a bestial, galloping motion.
<<Feel Maria Neutral 0.8 None>>
<<Feel Maria Sadness 1.0 None>>
<<Feel Joao Neutral 0.8 None>>
<<Feel Joao Fear 1.0 None>>
<<OBJECTIVE:0.0; Calm:0.0>>
<<Nod Maria Start>>
Joao: It was now or never.
Joao: "Do or die".
<<Nod Maria Stop>>

<<exit>>
===
```

B

Questionnaires

Use these following links to access the respective questionnaires:

Preliminary Experiment,

Textual Happy (T+),

Textual Dour (T-),

Video Dour with Automatic Alternation in Narrators (A-),

Video Dour with Emotional Alternation in Narrators (E-).

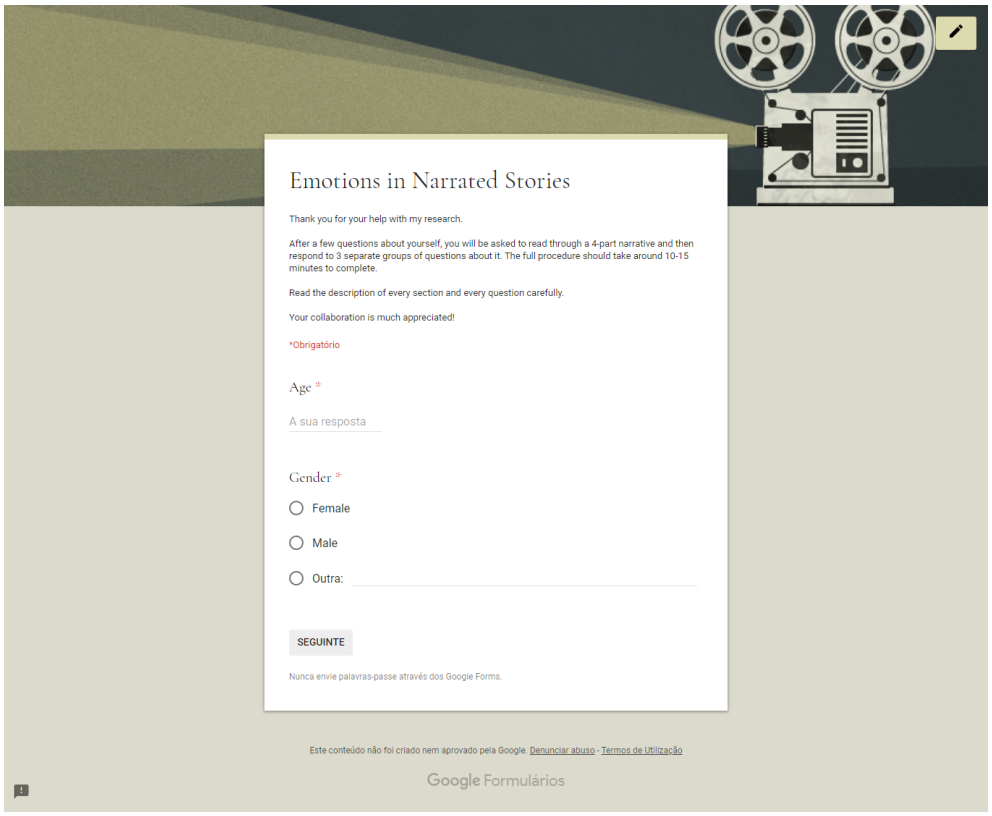


Figure B.1: First page of ALL final questionnaires.

Figure B.2: Second page of ALL final questionnaires.

Figure B.3: Page(s) of the final questionnaire(s) with the corresponding narrative (see from Figure B.8 to Figure B.12 for the full pages).

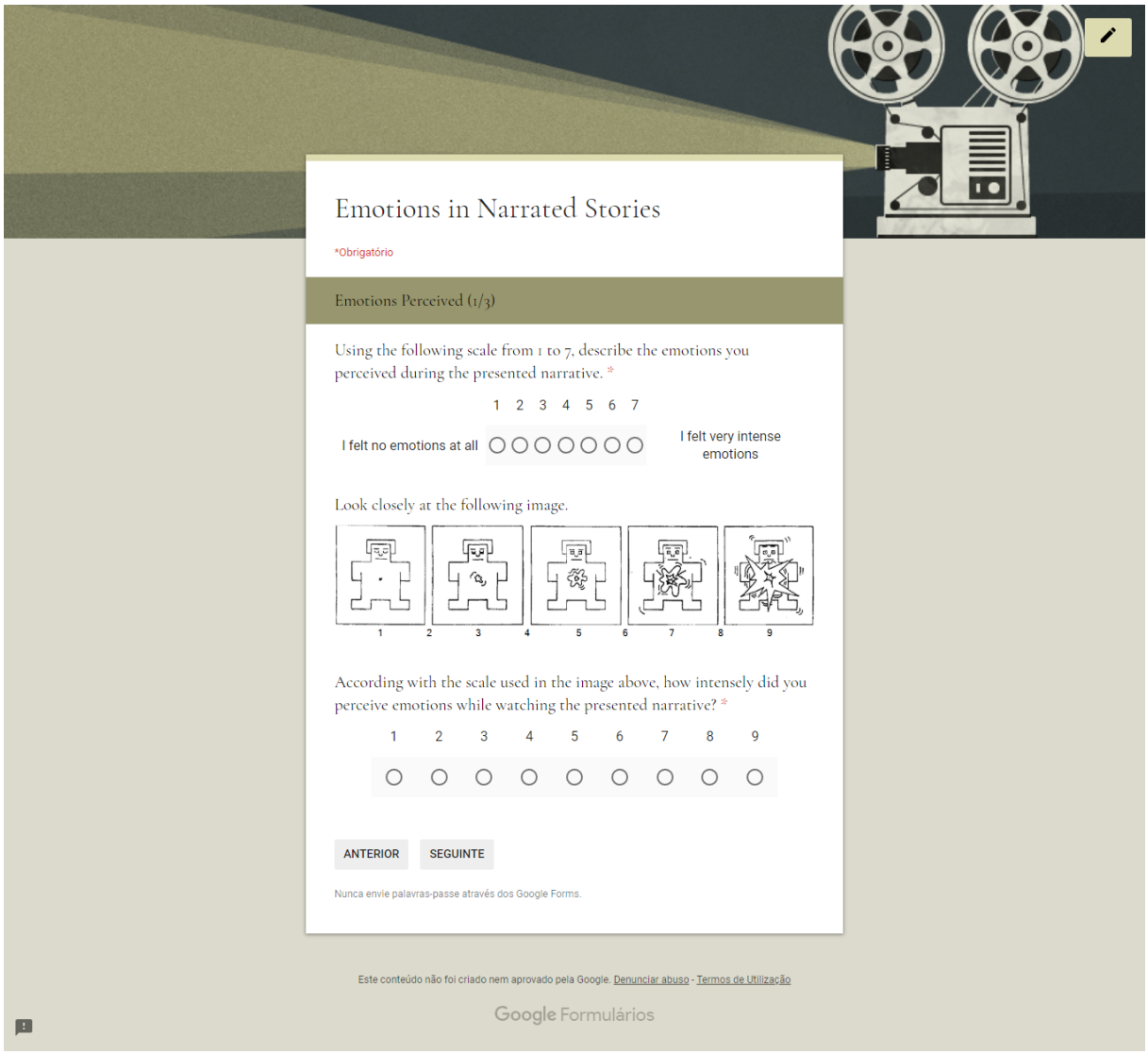


Figure B.4: Part 1 of Post-narrative questions for ALL final questionnaires.

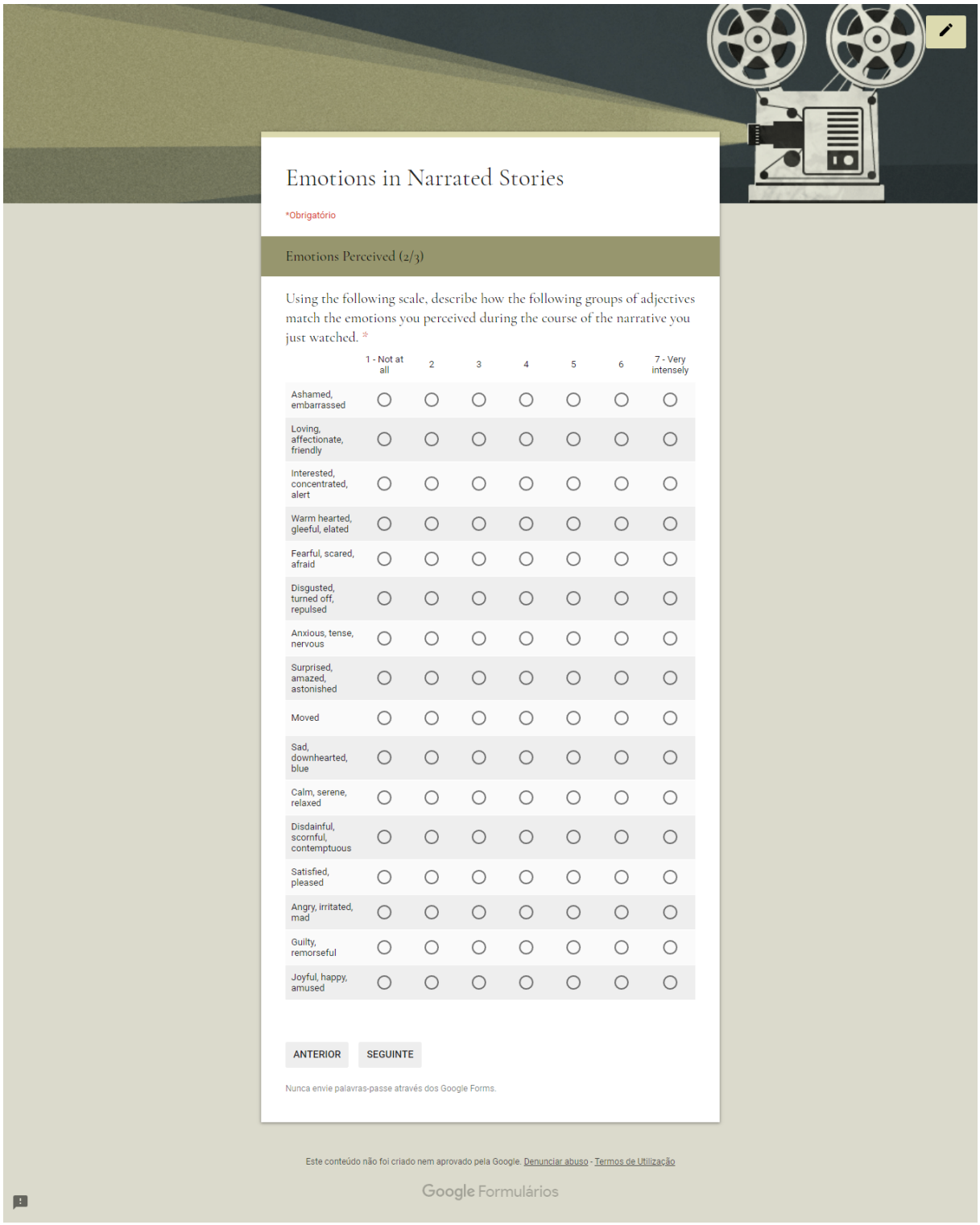
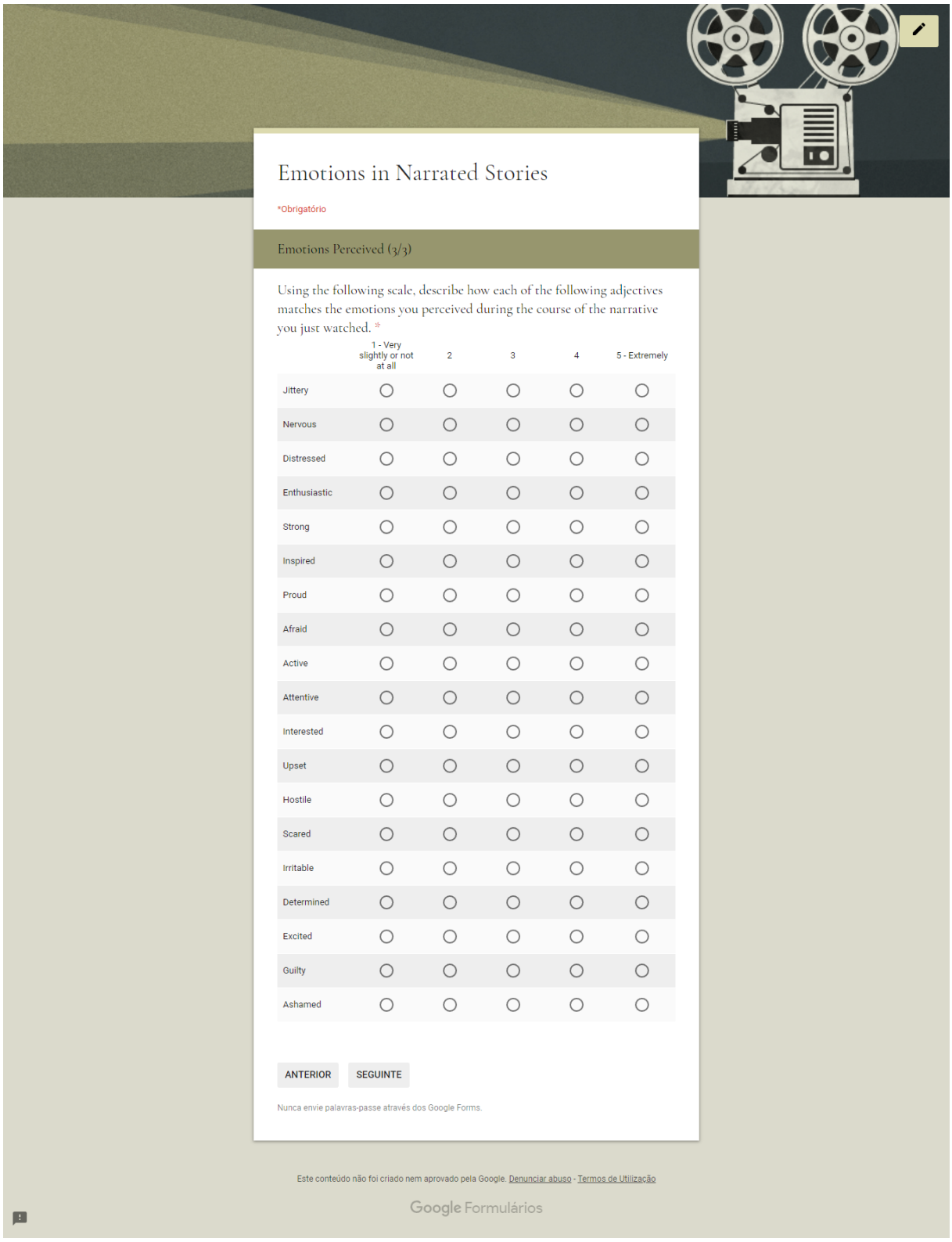


Figure B.5: Part 2 of Post-narrative questions for ALL final questionnaires.



Emotions in Narrated Stories

*Obrigatório

Emotions Perceived (3/3)

Using the following scale, describe how each of the following adjectives matches the emotions you perceived during the course of the narrative you just watched. *

	1 - Very slightly or not at all	2	3	4	5 - Extremely
Jittery	○	○	○	○	○
Nervous	○	○	○	○	○
Distressed	○	○	○	○	○
Enthusiastic	○	○	○	○	○
Strong	○	○	○	○	○
Inspired	○	○	○	○	○
Proud	○	○	○	○	○
Afraid	○	○	○	○	○
Active	○	○	○	○	○
Attentive	○	○	○	○	○
Interested	○	○	○	○	○
Upset	○	○	○	○	○
Hostile	○	○	○	○	○
Scared	○	○	○	○	○
Irritable	○	○	○	○	○
Determined	○	○	○	○	○
Excited	○	○	○	○	○
Guilty	○	○	○	○	○
Ashamed	○	○	○	○	○

ANTERIOR SEGUINTE

Nunca envie palavras-passe através dos Google Forms.

Este conteúdo não foi criado nem aprovado pela Google. Denunciar abuso - Termos de Utilização

Google Formulários

Figure B.6: Part 3 of Post-narrative questions for ALL final questionnaires.

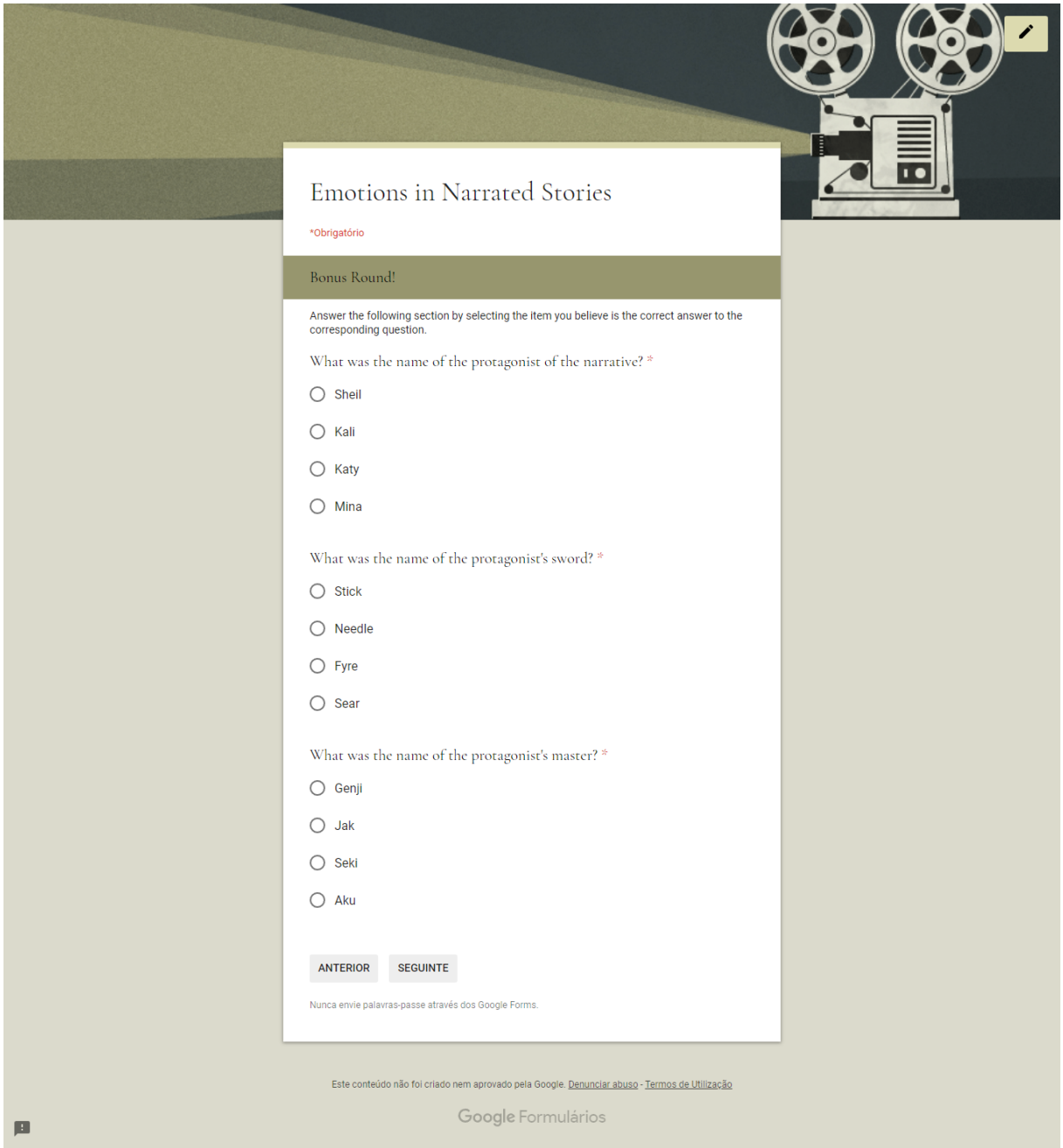


Figure B.7: Page with the validation questions for ALL final questionnaires.

Happy Narrative

This would be her first solitary venture into the wilds. Ganji, her master, insisted that she should do this by herself. "You're much too experienced to have this bag of old meat protecting you," was the last thing he said to her before she departed, and then he gifted her with his sword Sear, named for the simmering heat its blade generated when swung or thrusted. Tomorrow, Kali would hopefully put it to good use. She had been following Its trail for more than a day now. Sooner or later, it would end. When she was done with the blade, she carefully placed it in its sheath, and layed on her makeshift mattress of leaves and moss, using her pack as a pillow. "Tomorrow..." she remembered saying to herself as she fell asleep, "tomorrow, you're dead."

The torch's light was enough for her to get her immediate bearings inside the cave, but it also blinded Kali's eyes to the void outside the ring of light, which, at times, seemed almost alive with shifting thought and tentacle motion. Some years before, with Genji still carefully watching over her, they hunted a highly vicious nightcrawler that hid himself in a cave not unlike this one. They knew what it was capable of, having seen some of the gore it left in its wake. But they caught and killed it. The dark couldn't protect him from Sear. In the village, they were received with tremendous celebration and rejoice. They even brought out some of the leftover fireworks from New Year's Celebration, and fired them up into the stars. That was one of the happiest nights of Kali's life. She smiled at the thought, and the looming darkness felt like it had lost some of its initial weight on her. She walked on, blood trail still underneath her heels.

She came to a point where the cave became slightly wider, and the ceiling much taller, so much so, that the light of her torch couldn't even reach it. As her chest tightened, she drew Sear. Any sign of shifting movement, any slight noise at the edge of earing, any whiff of decayed flesh, any pair of eyes glowing in the midst of the gloom, her senses and muscles were ready to respond accordingly. The trail ended abruptly. As if in one moment the blood was steadily falling to the ground, and in another it had suddenly been cut off. A deep, guttural snarl, almost mocking in tone, came from behind her. And when she turned around, she saw Its two slitted yellow eyes, both screaming silently for her blood and flesh. She wasn't surprised.

Kali couldn't say if this rush of attacks had lasted 2 minutes or 2 hours. When It stopped, she had the the entirety of her coat and trousers ripped and bloodied. Her left shoulder was dislocated, so she couldn't move the arm dangling underneath it. Sear was still in her right hand, though. The torch she held in her teeth. But she knew her body couldn't take much more of this. "Last chance," she thought to herself. And with all of her remaining strength and will pulling for her body, she charged at It. Responding in tandem, It also charged at her in a bestial, galloping motion. It was now or never. "Do or die".

Figure B.8: Happy Text Narrative (T+).

Dour Narrative

The blood trail she was following led to an enormous cave. It's entrance, a wide-open mouth of dark gloom ripping out of the body of the hill's wall, broken and sharp stalactite and stalagmite fangs in wait of any entering prey. Grabbing a broken oak branch from the surrounding treeline, she took a bundle of dead leaves, wrapped them around one of the branch's ends with some linen cloth soaked in old licor and, after unbuckling Sear, her blade, from its sheath, she waved it for a few seconds in the air and pressed the scalding blade on the wet cloth. It caught fire instantly. Now, the moment she feared, the moment she eagerly waited for, was at hand. Up-and-down shivers needled the skin of her back and neck. Sweat filled the inside of her trembling leather gloves. Taking three deep breaths and a short prayer, she stepped into the darkness.

The torch's light was enough for her to get her immediate bearings inside the cave, but it also blinded Kali's eyes to the void outside the ring of light, which, at times, seemed almost alive with shifting thought and tentacle motion. Some years before, with Genji still carefully watching over her, they hunted a highly vicious nightcrawler that hid himself in a cave not unlike this one. They knew what it was capable of, having seen some of the gore it left in its wake. But they caught and killed it. The dark couldn't protect him from Sear. In the village, they were received with tremendous celebration and rejoice. They even brought out some of the leftover fireworks from New Year's Celebration, and fired them up into the stars. That was one of the happiest nights of Kali's life. Kali smiled at the thought, and the looming darkness felt like it had lost some of its initial weight on her. She walked on, blood trail still underneath her heels.

She came to a point where the cave became slightly wider, and the ceiling much taller, so much so, that the light of her torch couldn't even reach it. As her chest tightened, she drew Sear. Any sign of shifting movement, any slight noise at the edge of earing, any whiff of decayed flesh, any pair of eyes glowing in the midst of the gloom, her senses and muscles were ready to respond accordingly. The trail ended abruptly. As if in one moment the blood was steadily falling to the ground, and in another it had suddenly been cut off. A deep, guttural snarl, almost mocking in tone, came from behind her. And when she turned around, she saw Its two slitted yellow eyes, both screaming silently for her blood and flesh. She wasn't surprised.

She ran towards the Creature, swinging the blade Sear ahead of her, and thrusted the blade into It, but the Thing swiftly dodged her attack, and, with Its huge, bloated left arm, pounded her to the ground. Kali, all air suddenly rushing out of her chest, felt like she was hit by a battering ram. As she regained her breath, she couldn't help but smell It. A nauseous reek, a mix of rotten flesh, bile and sulfur. Sear still in hand, she picked up the dropped torch, its light weaker than before. But that was enough for Kali to catch a glimpse of Its crimson filled, hairy snout, rows of brownish, sharp teeth adorning a hungry, devilish grin. It jumped on her, swinging its arms and legs - dagger like claws in each - left and right, with Kali managing to dodge most of the incoming charge, but each time her blood was shed, the

Figure B.9: Part 1 of Dour Text Narrative (T-).

horror, the fear inside her mind, spread further through her limbs. And it was if the Thing felt revitalized, coming at her with ever increasing ferocity.

Kali couldn't say if this rush of attacks had lasted 2 minutes or 2 hours. When It stopped, Kali had the the entirety of her coat and trousers ripped and bloodied. Her left shoulder was dislocated, so she couldn't move the arm dangling underneath it. Sear was still in her right hand, though. The torch she held in her teeth. But she knew her body couldn't take much more of this. "Last chance," she thought to herself. And with all of her remaining strength and will pulling for her body, she charged at It. Responding in tandem, It also charged at her in a bestial, galloping motion. It was now or never.

Figure B.10: Part 2 of Dour Text Narrative (T-).

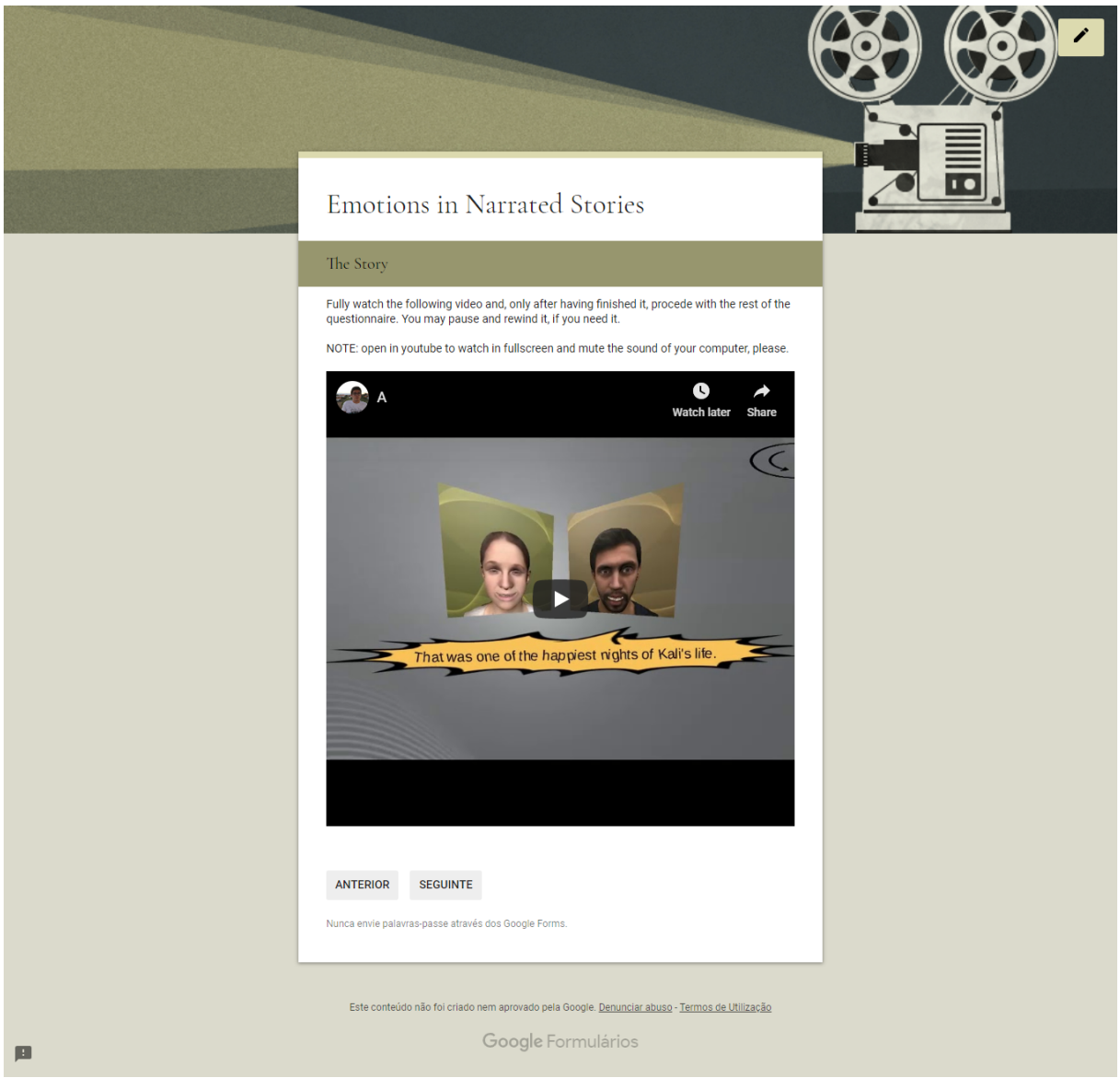


Figure B.11: Page of the video narrative in the final Questionnaire with Dour Narrative that uses Automatic Alternation between NPC Storytellers (A-).

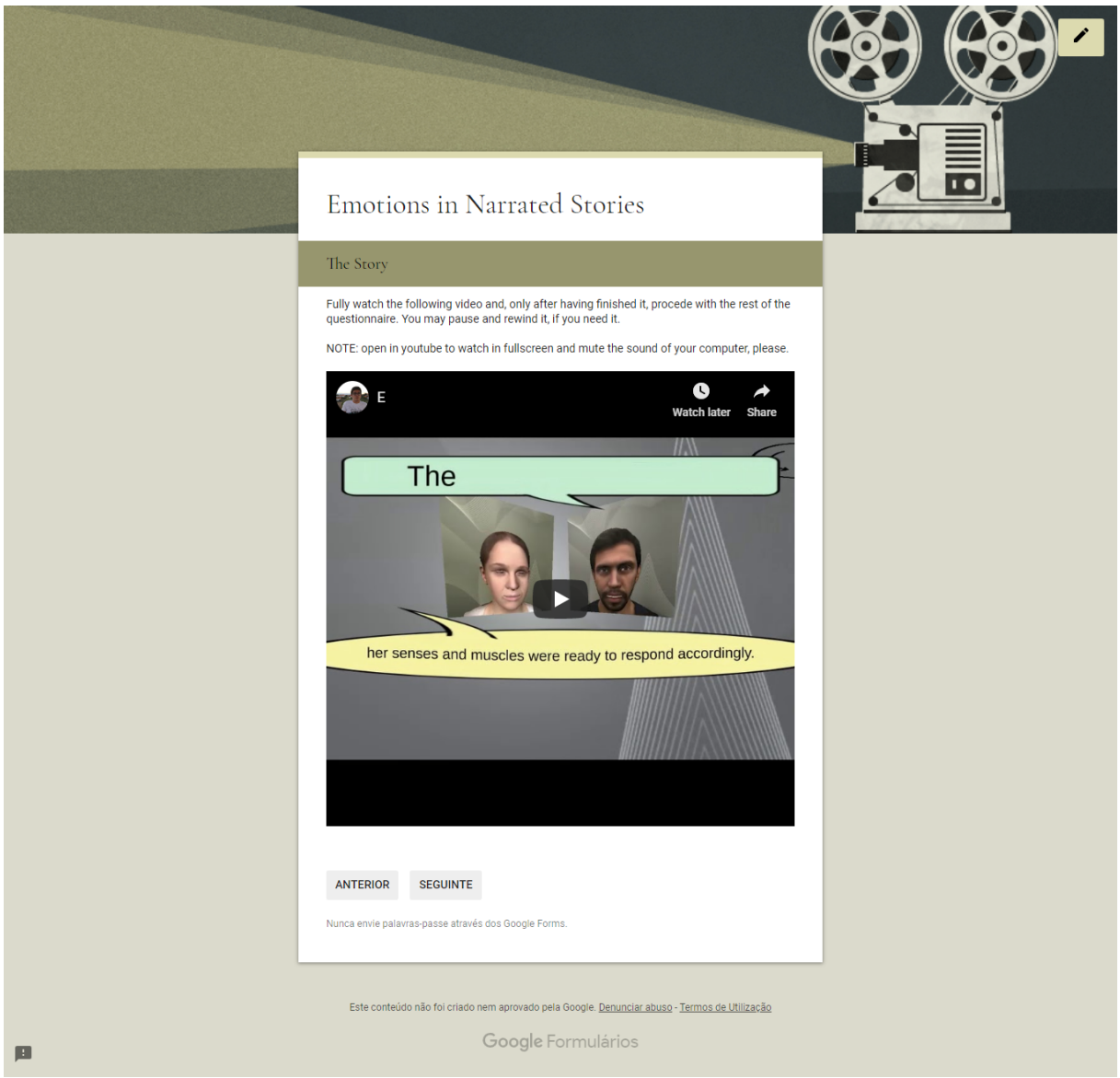


Figure B.12: Page of the video narrative in the final Questionnaire with Dour Narrative that uses Emotional Alternation between NPC Storytellers (E-).

C

Preliminary Questionnaire

Use these following link to access the questionnaire:

Preliminary Experiment,

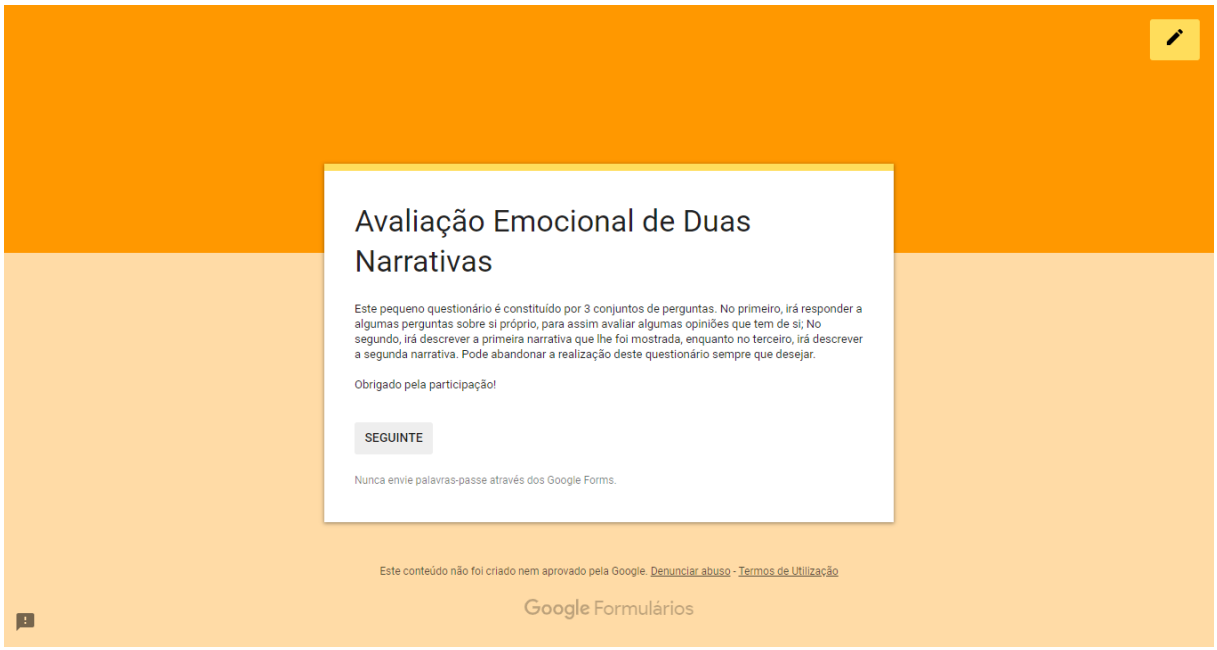
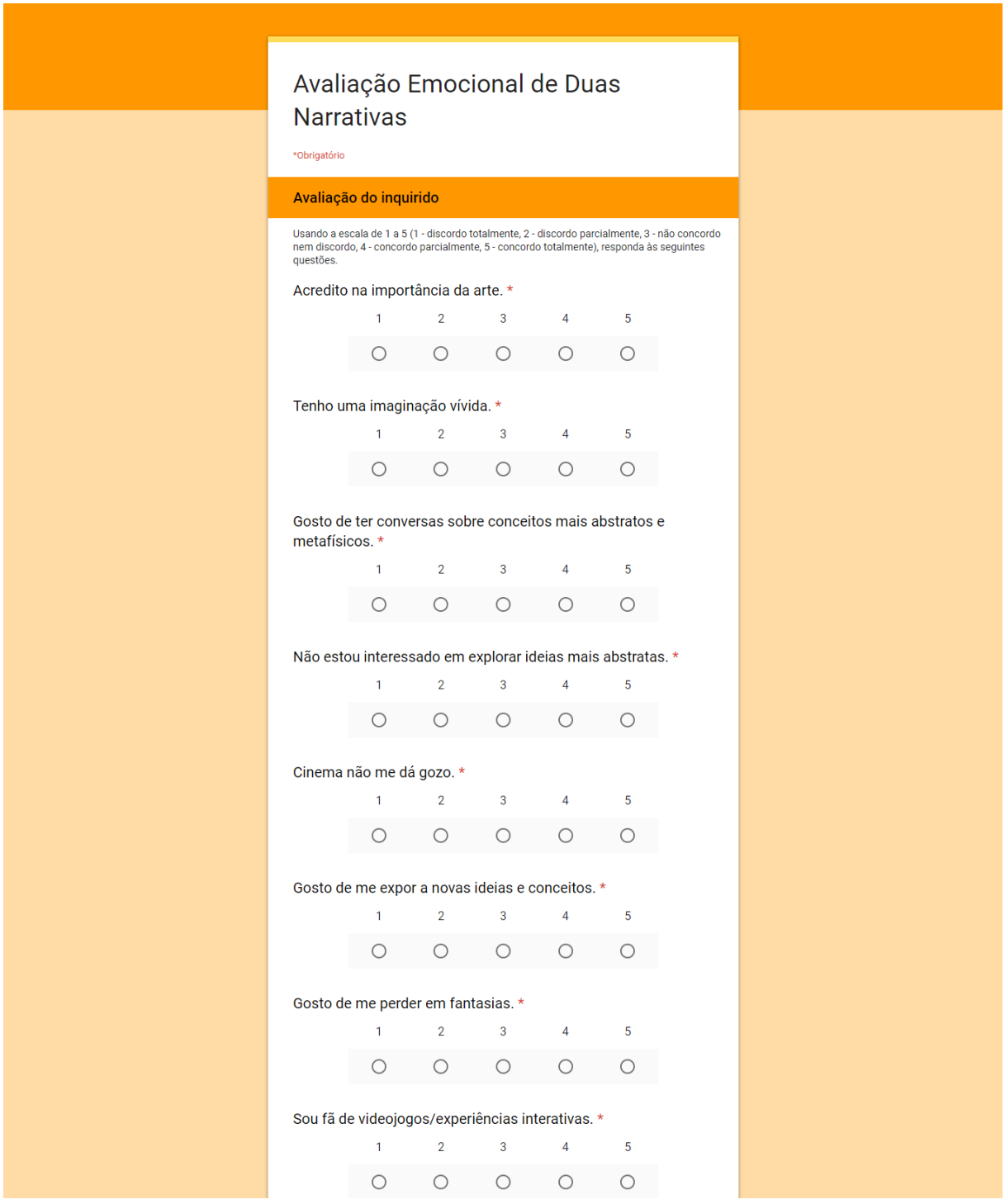


Figure C.1: First page of preliminary questionnaire.



Avaliação Emocional de Duas Narrativas

*Obrigatório

Avaliação do inquirido

Usando a escala de 1 a 5 (1 - discordo totalmente, 2 - discordo parcialmente, 3 - não concordo nem discordo, 4 - concordo parcialmente, 5 - concordo totalmente), responda às seguintes questões.

Acredito na importância da arte. *

1 2 3 4 5

Tenho uma imaginação vívida. *

1 2 3 4 5

Gosto de ter conversas sobre conceitos mais abstratos e metafísicos. *

1 2 3 4 5

Não estou interessado em explorar ideias mais abstratas. *

1 2 3 4 5

Cinema não me dá gozo. *

1 2 3 4 5

Gosto de me expor a novas ideias e conceitos. *

1 2 3 4 5

Gosto de me perder em fantasias. *

1 2 3 4 5

Sou fã de videojogos/experiências interativas. *

1 2 3 4 5

Figure C.2: Second page of preliminary questionnaire (first half).

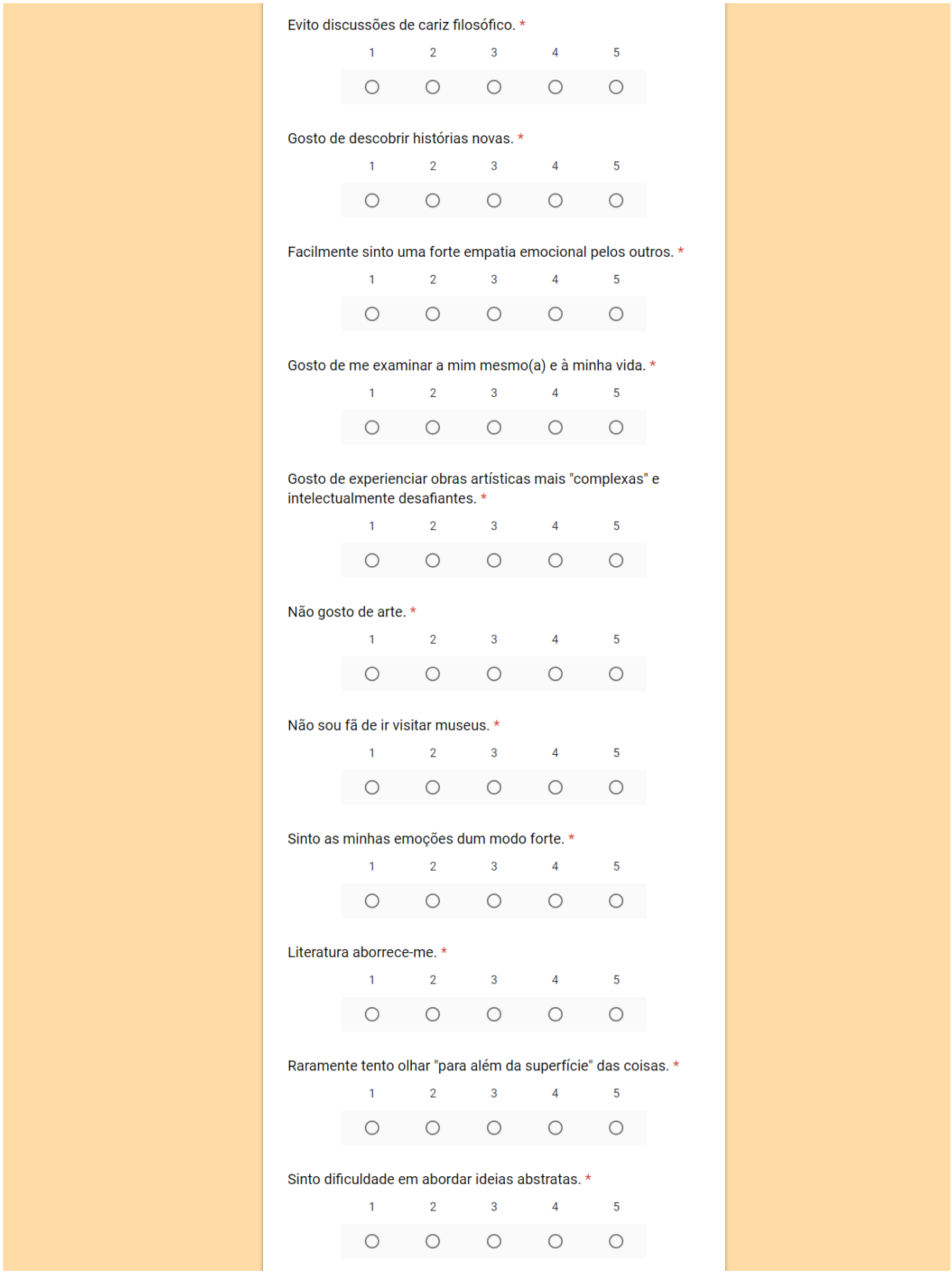


Figure C.3: Second page of preliminary questionnaire (second half).

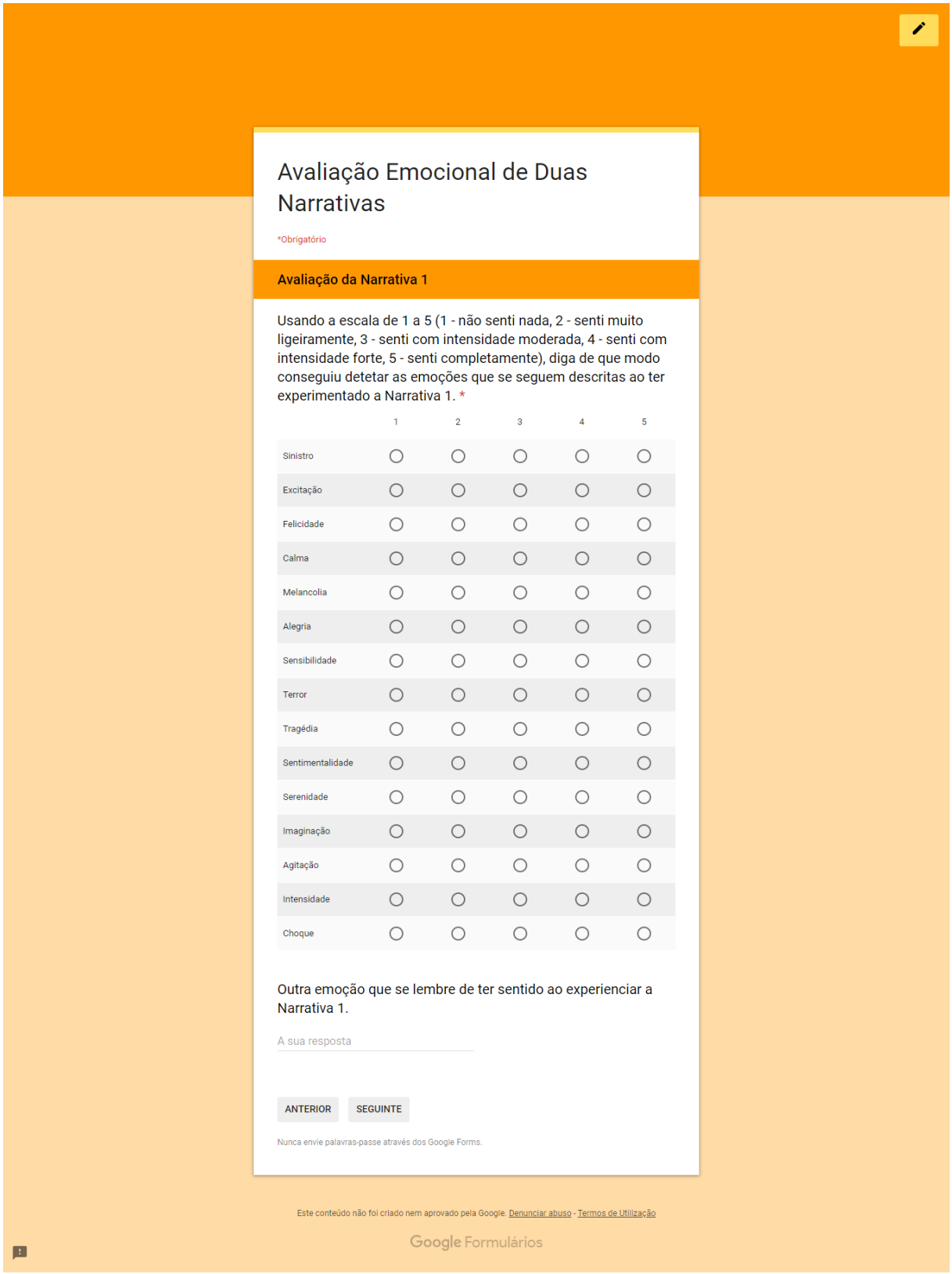


Figure C.4: Third page of preliminary questionnaire.

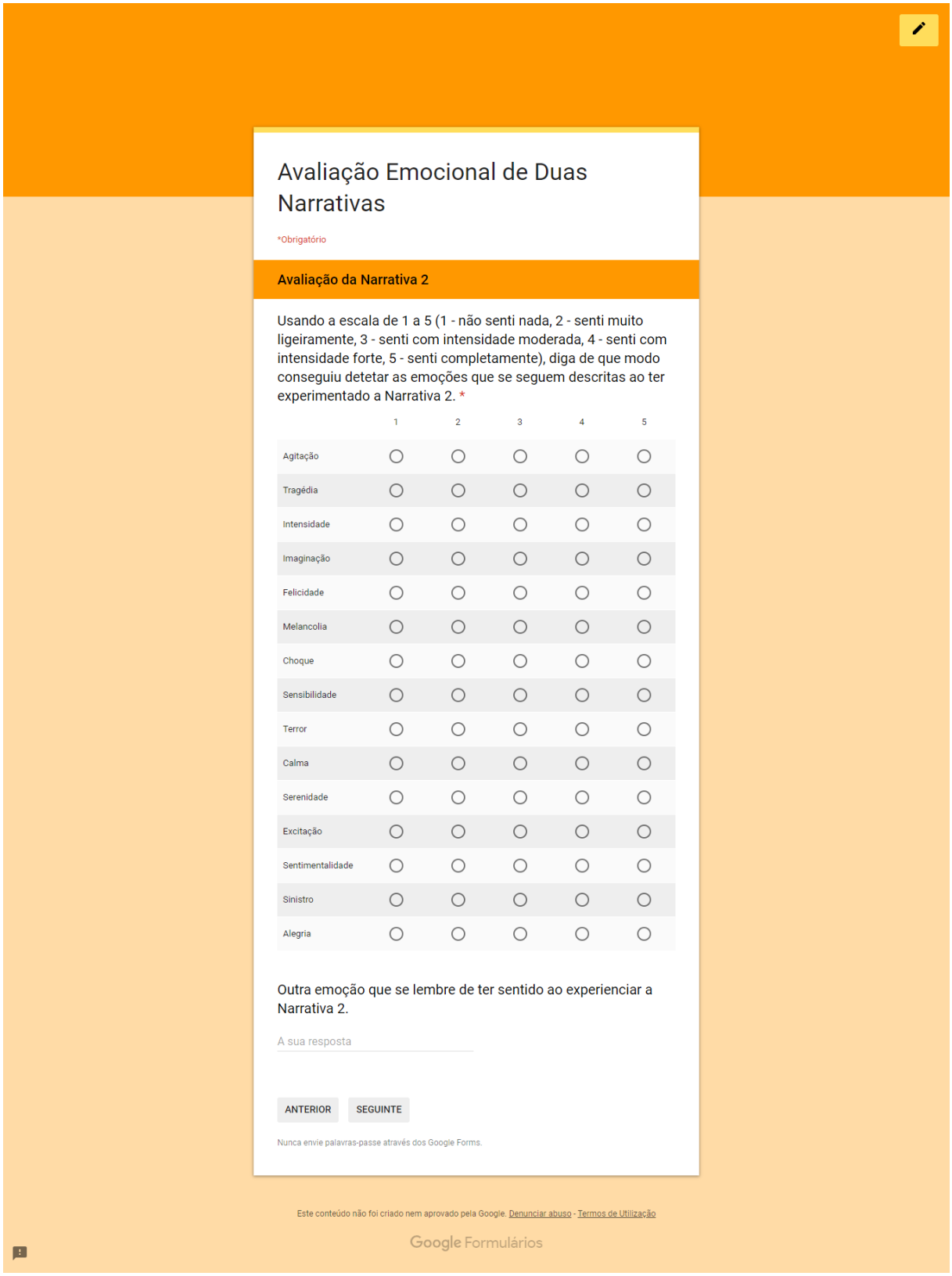


Figure C.5: Fourth page of preliminary questionnaire.