# Keeping PACE: Appraising Emotions to Enhance Gaming Experience.

by

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# Abstract

Artificial Intelligence (AI) techniques have been widely used in video games to control non-playable characters. More recently, AI has been applied to automated story generation with the objective of managing the player's experience in an interactive narrative. Such AI experience managers can generate and adapt narrative dynamically, often in response to the player's in-game actions. We propose, implement and evaluate a new AI experience manager, PACE, which predicts the player's emotional response to a narrative event and uses such predictions to shape the narrative to keep the player on an author-supplied target emotional curve.

# Preface

This thesis is an original work by Sergio Poo Hernandez. The user study which is part of this thesis, received research ethics approval from the University of Alberta Research Ethics Board, Project Name "PACE: Maintaining Emotional Impact in Automatically Generated Stories", No. Pro00046300, on April 28th, 2014.

A version of Chapter 4 has been published as Sergio Poo Hernandez, Vadim Bulitko and Emilie St.Hilaire, "Emotion-Based Interactive Storytelling with Artificial Intelligence", In *Proceedings of the Tenth Artificial Intelligence and Interactive Digital Entertainment Conference*, pages 146-152, The AAAI Press, 2014 and has contributions from Dr. Vadim Bulitko and Emilie St.Hilaire with concept formation and manuscript composition.

A version of Chapter 4, Chapter 5 and Chapter 6 has been accepted as Sergio Poo Hernandez, Vadim Bulitko and Marcia Spetch, "Keeping the Player on an Emotional Trajectory in Interactive Storytelling", In *Proceedings of the Eleventh Artificial Intelligence and Interactive Digital Entertainment Conference*, The AAAI Press, 2015 and has contributions from Dr. Vadim Bulitko and Dr. Marcia Petch on manuscript composition and they provided me with guidance on running the user studies.

To my family, and my closest friends. This would not exist without you.

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# List of Acronyms

**AI** Artificial Intelligence
**ASD** Automated Story Director
**C-DraGer** Case-based Drama manaGer
**CEMA** Culture-Emotion MAtrix
**DDM** Distributed Drama Manager
**EMA** EMotion and Adaptation
**EMG** Electromyography
**GEM** Generalized Experience Management
**MANOVA** Multivariate Analysis of Variance
**MDP** Markov Decision Process
**NPC** Non-player Character
**PACE** Player Appraisal Controlling Emotions
**PaSSAGE** Player-Specific Stories via Automatically Generated Events
**PAST** Player-specific Automated Storytelling
**PDDL** Planning Domain Definition Language

# Chapter 1

# Introduction

Storytelling is not only a way to transfer knowledge (Szilas, 2015) but also a means of eliciting emotions from the audience. A recent study on story evolution over serial reproduction suggests that people maintain affective dimensions (e.g., surprise) while modifying events in a story (Breithaupt et al., 2015). Video games add a new dimension to storytelling by allowing the audience to change the narrative through their actions. Such player agency has the potential to create personalized stories that the audience can connect with. Exploitation of this potential has been explored by numerous games, among them Bioware's *Mass Effect* (Bioware, 2010) and *Dragon Age* (Bioware, 2009) series with critical acclaim (VanOrd, 2014; Makuch, 2014).

An important element of story-telling is the emotional impact of the story; this is on the author's mind across all media. For example, in movies, the director and editor will work on adding different elements to a scene (light composition, set, acting, music) in the hopes that at least one of those elements will create the desired emotional impact on the audience (Tan and Fasting, 1996; Smith, 2003).

Unlike movies, where the audience is passive, video-games are interactive and have to account for the audience's choices. Usually games have a narrative tree showing all possible story possibilities and the game chooses events from this tree depending on the player's actions. How can a video-game developer hope to elicit certain emotions from an unknown player who is shaping the story dynamically by controlling their in-game avatar?

Video game developers have tackled this challenge in a variety of ways (Figure 1.1). One possibility is to make the narrative emergent. Games such as the *Fallout* series (Bethesda Softworks LLC, 2012), while having a main storyline, populate the game world with a great number of modular mini-narratives (side quests)


Figure 1.1: Clockwise from top left: *Fallout 3*, *Sims 3*, *Mass Effect* and *Half-Life 2 Episode 1*.

and characters for the player to interact with in the hope that the player will find an event that will have an emotional impact on him. This modularity approach helps the player transition from the main quest to any of the side quests easily. The downside of this approach is that the main story takes a backseat and usually lacks emotional tension. For instance, in *Mass Effect 2* (Bioware, 2010) the player is told that the galaxy is on the brink of destruction yet they solve domestic conflicts, help secure crew member's family and enjoy dancing in a night club.

Another approach is relying on emergent narratives, example of games using this approach is *The Sims* series (Maxis, 2000). *The Sims* works as a virtual doll house, where the player gains control of any number of characters in a virtual neighborhood and leads them through their daily life, ranging from going to work to cooking to falling in love. The game lacks a storyline, but the interactions that are at the core of the game allow the players to create their own stories.

An opposite approach to emergent narratives is to write a linear story and hope that the topic is universal enough to elicit desired emotions from a broad range of players. The development team works to add the same elements, as movies do, to a scene to create a desired emotional impact in the audience. Like in movies this might lead to players having an emotional experience, but they might also feel like their actions have no effect on the story. A classic example of this approach is *Half*

*Life 2* (Valve, 2004) where the human kind is oppressed by technologically advanced aliens. In this case the story resonated with enough players that it garnered several Game-of-the-Year-Awards (Wikipedia, 2015).

While the previous examples show how games currently try to elicit emotions from the player while giving them different degrees of freedom to modify the environment, combining a narrative tension arc and open-world exploration is an outstanding challenge (Petit, 2014). Researchers in Artificial Intelligence (AI) have tackled this challenge by attempting to manage the player's experience on a per-player basis. Such AI experience managers approximate a human game master — a person who in the world of traditional pen-and-paper role-playing games assesses players' emotions and shapes the story to elicit certain emotional responses, determined by the game master, from them (Laws, 2002). For instance, the *Automated Story Director* (Riedl et al., 2008) modified the story of *The Little Red Riding Hood* (Grimm and Grimm, 1857) delivering goods to her grandmother in response to the player's actions (e.g., killing the wolf in the forest) so that the authorial goals (e.g., the grandmother needs to be eaten) are still accomplished. To do this, the AI manager used a formal encoding of the domain of the narrative discourse and ran an automated planner to generate continuations of the narrative to accomplish authorial goals. The downside of this approach is that it becomes more difficult for the game developers to anticipate and control the player's emotional response. To this end, AI researchers have attempted to model the player's state explicitly and shape the narrative specifically to influence it. For instance, PaSSAGE attempts to infer the player's inclinations towards different playstyles and then selects the next bit of narrative to maximize the player's perception of fun and agency (Thue et al., 2007, 2011).

Frequently, multiple automatically planned narrative continuations can achieve authorial goals. For instance, if Red (controlled by the player) kills the wolf early in the game, the authorial goal of eating her grandmother can be achieved by either introducing another wolf or resurrecting the deceased wolf via a magic fairy. Which plan would elicit the desirable emotional response from the player? Our work answers this question by computationally predicting the player's emotional reactions to automatically planned narratives and then choosing the narrative predicted to elicit the reaction closest to that specified by the author. The advantage of our approach is that the author of such an interactive narrative does not even need to specify concrete narrative events/goals (as was required by previous managers (Riedl et al.,

2008; Ramirez Sanabria and Bulitko, 2014)). Instead, he/she can specify the desired emotion to be elicited from the player at various stages of the story. In effect, the author specifies a target *emotional trajectory* at story development time. The AI manager then attempts to keep any player on it during the game playthrough by selecting the next bit of narrative from the candidates generated by an AI planner. We let the author explicitly specify a trajectory in a space of emotions that they would like their players to experience. So instead of providing concrete narrative goals (e.g., "Grandmother is eaten by the wolf" in an interactive version of *The Little Red Riding Hood* story (Riedl et al., 2008)) and hoping that accomplishing these will somehow elicit the needed emotional response from the player, we let the author specify emotional "key frames" at certain narrative points. For instance, the author can specify that at a certain point into the game the player should be hopeful but also somewhat afraid. Our AI system will then pick concrete narrative events which it expects will put the particular player in such an emotional state at the specified time.

We accomplish this goal by extending and combining several existing AI approaches to the interactive narrative experience management. Specifically, we encode the narrative world in a planning language and represent the stories themselves as plans in the spirit of the *Automated Story Director* (Riedl et al., 2008). We infer the player's inclinations towards different playstyles using the player model inspired by PaSSAGE (Thue et al., 2007). We use an appraisal model of emotions to predict the player's emotional response to a candidate narrative (Ortony et al., 1990; Marsella and Gratch, 2003; Lazarus, 1991).

## 1.1 Thesis Contributions

The first contribution of this thesis is a novel combination of several existing AI approaches and the introduction of a new computational model connecting playstyle modeling to goal inference to emotion prediction to narrative selection. The resulting approach is called *Player Appraisal Controlling Emotions* (PACE). Second, we present an implementation of PACE by adding it to a novel narrative-based video game called *iGiselle*. Finally we evaluate the effectiveness of PACE via a formal user study. We found that PACE may be capable of increasing the player's feeling of fun for people who do not identify themselves as gamers, although the results are inconclusive.

Parts of the work presented in this thesis has been previously published in the papers: *A Call for Emotion Modeling in Interactive Storytelling* (Poo Hernandez and Bulitko, 2013), *Emotion-based Interactive Storytelling with Artificial Intelligence* (Poo Hernandez et al., 2014) and *Keeping the Player on an Emotional Trajectory in Interactive Storytelling* (Poo Hernandez et al., 2015).

The rest of the thesis is organized as follows. We formulate the problem more precisely in Chapter 2. Chapter 3 reviews relevant existing work and its applicability to the problem at hand. Our approach is presented in Chapter 4. We discuss our implementation within the interactive ballet video game in Chapter 5. And the planned empirical evaluation and the hypotheses it will test in Chapter 6. We then conclude with directions for future work.

# Chapter 2

# Problem Formulation

The problem we set out to solve in this thesis is to enhance the player's playing experience, increase his/her sense of fun, agency and believability, by keeping his/her emotions close to an author specified emotion curve. To solve this problem we divide it into two objectives. First, we would like the player to travel along an author-specified emotional trajectory. Second, we want to give the player a sense of narrative agency by allowing them to meaningfully shape the story and get a feeling that their choices ultimately matter. In other words, how can we ensure that a player will experience a particular emotional trajectory, defined by the story's author? And by doing so will this increase the player's sense of agency and fun? We attempt to solve both sides of the problem in the context of AI-managed interactive narrative. In this context, narrative events are queued into the game an AI experience manager and are influenced by the player's choices. These choices are expressed by his or her avatar's actions and the author's desires expressed in the form of a target emotional trajectory for the player. For example, if the player avoids dangerous situations (enemies, dark corridors) the manager can infer the player is fearful of getting hurt, with this information it can select the next narrative event, if the author specified a desire for the player to feel fear the manager can try to guide the player toward a dangerous situation.

The *Generalized Experience Management* (GEM) framework (Thue, 2015), posited the idea that video-game narrative managers can be represented as a Markov Decision Process (MDP) with the player being the decision agent. A MDP is a five-tuple $(S, A, P, R, \gamma)$ where:

- $S$ is a set of states.
- $A$ is a set of actions.

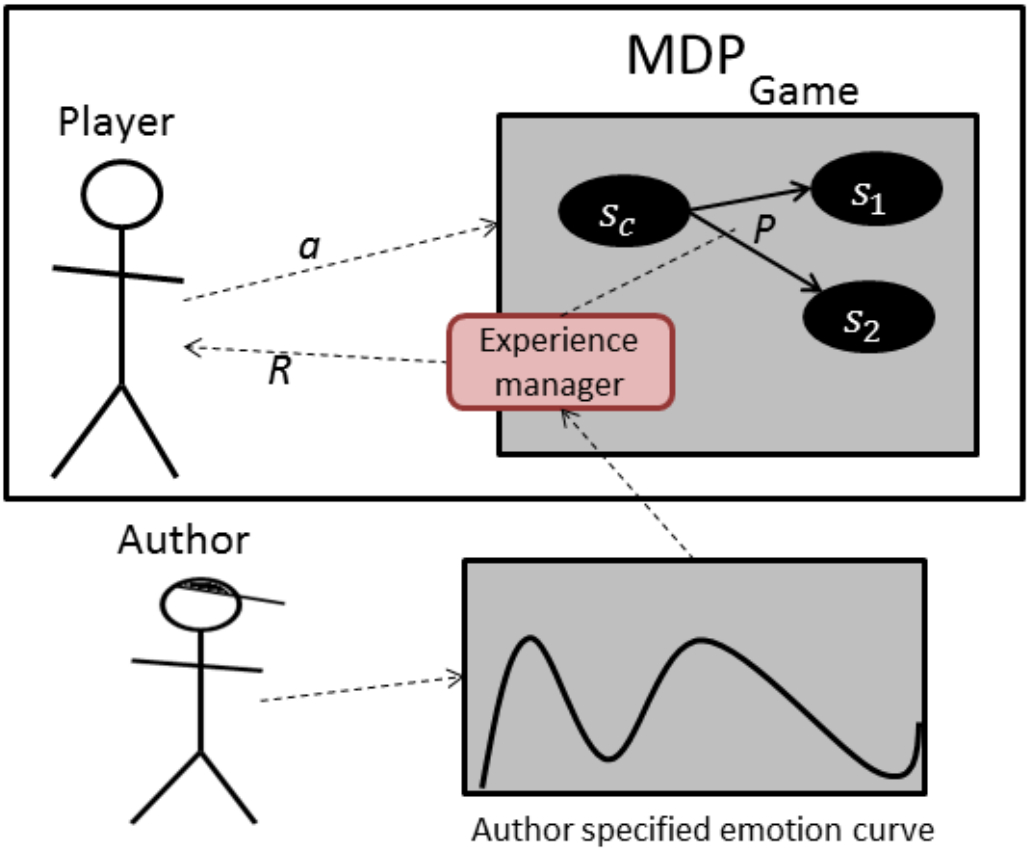


Figure 2.1: Experience manager modifies the MDP.

- $P$ is the transition distribution with $P_{sa}(s')$ denoting the next-state distribution after taking action $a$ in state $s$.
- $R$ is the reward function.
- $\gamma$ is the discount factor.

In the context of narrative managers states are narrative events, actions are the narrative choices the player makes. The MDP structure can be defined to ensure plot consistency (e.g., if the player kills the wolf early in the game, Red cannot be eaten by the said wolf later). Unbeknownst to the player, her actions are monitored by an AI experience manager which uses this information to adjust the MDP on the fly. As presented by the framework, having the player being the decision agent presents a problem as the MDP does not know what the reward function is. Since $R$ is dependent on the player it is necessary to create a representation of the player if we are to compute $R$. Some managers, such as PaSSAGE (Thue et al., 2007, 2011) and PAST (Ramirez and Bulitko, 2012; Ramirez et al., 2013) try to determine how

much fun the player will have playing such content and use this as part of their reward function (Figure 2.1). The rest of this thesis presents the implementation of a variety of AI techniques that define $R$ as to meet our two objectives, have the player travel an author-specified emotional trajectory and give the player a sense of narrative agency.

Research in the field has shown that it is possible to observe a player's actions and infer information from them (e.g., objectives, play-styles) (Aylett and Louchart, 2008; Thue et al., 2011). Is it possible then, from such observations, to determine a player's emotional state and leverage this to present emotionally engaging events? Will using this approach as input for a reward function in a narrative manager help increase the player's feeling of *fun*, *agency* and *plot/character believability*? These are the questions we try to answer in this thesis. In order to know if we have succeeded we will have players play a story-focused game using a narrative manager that makes narrative selection based on how close the player is emotionally to an author-specified trajectory as a reward function, and measure the player's self-reported feeling of *fun*, *agency* and *plot/character believability* during their playthrough.

Therefore, in our problem formulation, an AI experience manager takes a target emotional trajectory for the narrative as an input and outputs a sequence of narrative segments consistent with the player's in-game actions as well as attempting to keep the player on the emotional trajectory. Such manager's performance would be measured by the increase of the player's sense of agency fun and believability. In other words, we want to find a narrative ($n_j$) that maximizes the player's sense of fun, agency and believability with the smallest deviation between the narrative's emotion curve and the author defined emotion curve. The $R$ in this model is based on the player's emotional representation and $n_j$'s emotion curve should be computed based on $R$.

# Chapter 3

# Related Work

Existing work relevant to the problem introduced in the previous chapter comes from two fields of research.

## 3.1 Experience managers

The first field we will talk about is AI experience management in the context of interactive narrative in video-game-like systems. The *Automated Story Director* (ASD) (Riedl et al., 2008) represents the narrative as a plan and uses the AI planner *Longbow* to build a narrative from a formal description of the story world and *a priori* given authorial goals. When the player makes an action that causes the narrative to break, the planner is invoked to try to find a new narrative that still meets the authorial goals and presents it to the player. Not all plans (i.e., sequences of events) result in interesting and emotionally rich narratives, and depending on how specific the authorial goals are the new plans might have similar events that might make the resulting narratives indistinguishable from each other. ASD lacks any model of the player's emotions or playstyle preferences. Instead, it forces the author to manually build an exemplar narrative. During the game, the player is monitored for rupturing the exemplar narrative by taking in-game actions. Such ruptures are then repaired by invoking an automated planner *Longbow* (Young, 1994). While a narrative rupture can be repaired in multiple different ways, the planner selects the repair most similar to the handcrafted exemplar narrative thereby pulling the player back towards the original story. The lack of explicit player-specific emotion modeling prevents ASD from solving our problem by itself. We will, however, incorporate parts of ASD in our solution.

### 3.1.1 Player modeling

Explicit playstyle modeling in interactive storytelling was implemented in *Player-Specific Stories via Automatically Generated Event* (PaSSAGE) (Thue et al., 2007, 2011) where the player's actions were mapped to inclinations towards five distinct playstyles borrowed from pen-and-paper game mastering (Laws, 2002). The inclinations were used to select from a handcrafted library of narrative segments in an attempt to maximize the player's feelings of enjoyment and agency. PaSSAGE neither allowed the game designer to specify an arbitrary emotional trajectory to keep the player on nor explicitly modeled the player's emotional state. In order to use PaSSAGE the author has to develop all possible story branches, since the manager only chooses from a pool of events assigned to that particular point in time. While PaSSAGE cannot solve our problem by itself, we will use a PaSSAGE-inspired playstyle model in our approach.

*Player-specific Automated Storytelling (PAST)* (Ramirez and Bulitko, 2012; Ramirez et al., 2013) combined the AI planner of ASD and the playstyle model of PaSSAGE in an attempt to repair player-induced ruptures in the exemplar narrative in a player-specific way. *Longbow* within PAST combined proximity to the exemplar narrative with predictions of the player's enjoyment to select the best repair to a rupture. To predict the amount of fun the player would have along a candidate repair, PAST used a PaSSAGE-style model of playstyle inclinations, automatically updating it from the player's actions. This prediction of fun along a possible narrative can be viewed as rudimentary emotion modeling. However, it is insufficient to solve our problem as PAST did not allow the author to specify an arbitrarily shaped emotion curve even for fun, instead always attempting to maximize it. Furthermore, PAST could not be easily extended to support other emotions. There was neither explicit predictions of player's emotional response to various narratives nor a mechanism for the author to specify different emotional targets at different story stages.

Another approach to player modeling is presented by Case-based Drama manaGer (*C-DraGer*) (Sharma et al., 2010) which tries to maximize the player's interest in the game by guiding them towards actions that previous players, who have acted similarly, have found interesting. In order for this manager to work it requires a database of cases to be developed in order for it to be able to interfere and guide

the experience. *C-DraGer* tries to maximize the player's interest in the game and does not model the player's emotions.

## 3.2 Emotion modeling

The other field of existing work focuses on inferring a player's emotional state (Lin et al., 2012). For narrative-rich games the models based on goal-appraisal appeared a natural fit. Such models compute the player's emotional state as a result of the interaction between the player's goals and the likelihood of him or her achieving them. To illustrate, the possibility of achieving a goal elicits the emotion of hope while a certain success elicits joy. A well-known appraisal model is OCC (Ortony et al., 1990). OCC is capable of modeling 22 different emotions and has been used in several systems such as EM (Reilly, 1996), *Émile* (Gratch, 2000) and *FearNot!* (Aylett et al., 2005, 2007). Systems capable of identifying emotions in fables implementing a Discrete Event Calculus of OCC have been successful (Sarlej and Ryan, 2011). While such work show that a computational implementation of OCC is possible it is used only to identify what emotions characters in Aesop's fables feel and not used to model a player in an interactive environment.

EM is one of the first systems to include emotion modeling. It uses the OCC model to create NPCs that react emotionally believably when player's interact with them. The NPC is annotated with the goal desirabilities it will pursue and uses these with annotations in the events that determine the likelihood of obtaining such goals. Using these values it appraises the NPC's emotions. This system is built for NPCs and never models the player's state.

*Émile* computes the probability of an NPC's success based on its current intentions and the plan the agent has developed to achieve those intentions and uses this probability to determine the NPC's emotional state. As part of computing the probability of success of each goal, it compares the plans of the different NPC's and how they might interfere among themselves, for instance if there is an NPC that wants to go shopping and needs a car and another is taking the only car earlier to work *Émile* will update the first NPC's plans with the knowledge the car will be unavailable and therefore its plan is unachievable. As was the case with EM the system is built for NPCs and never considers a player interacting with them.

*EMotion and Adaptation* (EMA) (Marsella and Gratch, 2003) compliments an appraisal-based emotion modeling with a coping mechanism and thus can be used to

control an NPC's appearance (Kenny et al., 2007) as well as actions within a game. EMA is only an emotion modeling tool, it is not an experience manager, hence it is insufficient to solve our problem by itself. However such a model can be part of our solution, in fact, we incorporate an appraisal-style model into our solution.

*FearNot!* is a didactic game whose objective is to teach children how to handle bullies. It uses emotion modeling in order for the NPCs to display realistic emotions. The modeling is only for the NPCs and the player is never modeled, so it is not trying to keep the player on a particular emotion curve. It only ensures that the NPC characters react realistically to the player.

Several AI experience managers have represented the player's emotions and used them to shape the narrative. *Moe* (Weyhrauch and Bates, 1997) was one of the first experience managers to use a target intensity curve and annotations on narrative events supplied by the author to guide the narrative. A similar approach is implemented in *Façade* (Mateas and Stern, 2003) where each plot point is manually annotated with a value representing the tension it introduces to the story. Then *Façade*'s experience manager chooses the plot point whose tension would be closest to the target tension curve provided by the author. A similar approach is also used in *Distributed Drama Management* (DDM) (Weallans et al., 2012) where the non-playable characters model the player's current and future emotions and use them to choose an action to perform. This approach is called double appraisal and as its name implies DDM appraises the player's emotion twice for each event. *Moe* and *Façade* do not use explicit player modeling, and it is assumed that all players react in the same way to a narrative event. DDM does model the player's emotions through the interaction with NPCs, however because it is NPC-centric, if the NPC's goals and actions are contrary to what the story requires to elicit a certain emotion from the player, DDM will not be able to adapt the story to elicit such emotion. Other examples of double appraisal (Aylett and Louchart, 2008) have been shown to increase the player's interest in the characters and story of the game, however such approaches only select the event that will cause the highest intensity emotion (hope or fear), even if the author prefers the player to feel hope if there's an event that will cause a higher intensity of fear than the highest possible intensity of hope, the fear event will be presented to the player.

With advances in biometric readers, researchers have attempted to explicitly read the player's emotional state and use it to shape the game. It has been shown that

machine learned models can identify emotions from EEG data. For instance, HAF-HOC scheme (Petrantonakis and Hadjileontiadis, 2010) was used to identify between the six basic emotions from previously captured EEG data. Skin conductance, heart rate and facial electromyography (EMG) can be used to infer the player's level of tension and thus dynamically adjust the layout of a game level and enemies encountered by the player (Nogueira et al., 2013). A similar but sensor-less approach was implemented in the commercial game *Left4Dead* where the tension level of the player inferred from observable variables (e.g., avatar's health level and enemies killed) was used to modulate the influx of enemies the player combats (Booth, 2009). While the approach allowed the game designer to specify an arbitrary target tension curve, the changes to the game were limited to elements of the gameplay, not affecting the narrative. Furthermore, biometric-driven approaches can directly assess only the player's current state whereas planning a forthcoming narrative event requires a prediction of the player's emotional response to it.

In summary, none of the related work reviewed in this section can solve our problem directly. However, most contain elements (e.g., playstyle modeling, narrative generation with AI planning) that can be incorporated into our solution.

# Chapter 4

# Proposed Approach

When choosing the best narrative to present to the player, the manager should select the one that it predicts will elicit emotions in the player closest to those the author originally intended. Therefore, the manager should be provided with an emotional trajectory for the whole story by the author, and its aim is to provide narrative content that the player finds fun, believable, while keeping him in this author-specified trajectory.

As we described in the introduction, our solution, PACE, combines elements from existing AI experience managers in a novel approach. We will first illustrate the ideas with an example and then follow up with algorithmic details.

## 4.1 Intuition

Consider an interactive story based on the classic Romantic ballet *Giselle* (Gautier et al., 1841) where the player controls the titular heroine. At the end of a ballet class, the player decides to leave the studio (Figure 4.1) and head out to a party. At the party Giselle encounters Beatrice, a rival ballerina (Figure 4.2, left). It is now up to the AI experience manager to select the next bit of narrative for the player to experience. Using the automated planning approach from the ASD, PACE computes two possible narratives with different scenarios: (i) the encounter between Giselle and Beatrice escalates to an open confrontation (Figure 4.2, center) or (ii) Giselle apologizes to Beatrice and defuses the situation (Figure 4.2, right). Which one should be presented to the player?

As the goal is to elicit a specific emotional response from the player as determined by the target emotion curve specified by the author, the answer depends on the player's reaction to each of the two narrative candidates. To make the selection

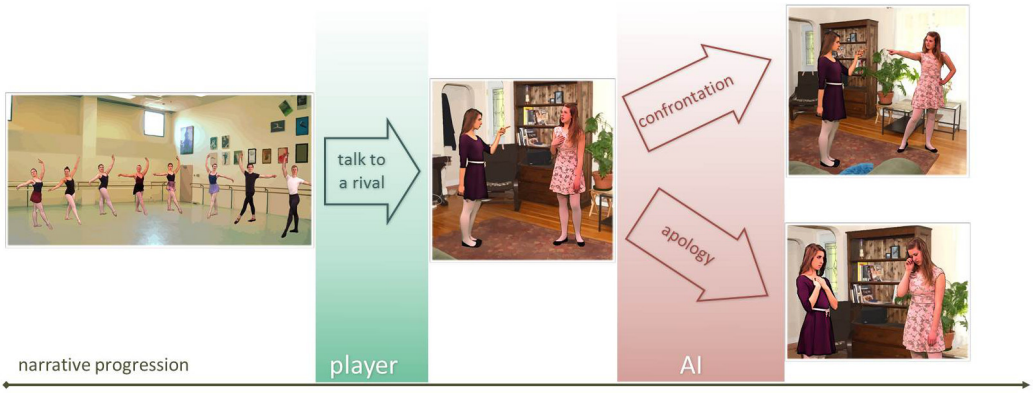


Figure 4.1: The player goes to a party. What happens next?

Figure 4.2: Giselle encounters Beatrice at a party (left). The encounter can escalate to an open confrontation (center) or be defused with an apology (right).

PACE predicts the player's emotions using an appraisal model and compares them to the target emotion curve. Suppose the author specified a target curve for the evolution of the player's hope, shown in Figure 4.5. Then PACE will predict the emotional intensity of hope elicited in the player by confronting her rival as well as by apologizing to her and choose the narrative to keep the player closer to the target curve.

## 4.2 Algorithmic Details

In the MDP-based framework introduced in Chapter 2, PACE operates as shown in Algorithm 1. As the inputs, the algorithm takes the set of narrative states $S$, the set of player's narrative-changing actions $A$, the MDP transition function $p$, the initial narrative state $s_1$, a set of final states $S_f \subset S$ and sequence of emotional states that the author would like the player to follow: $\bar{e}_t^*, t \in \{1, \dots\}$.

**Algorithm 1:** PACE

**inputs** : narrative space $(S, A, p)$, narrative start state $s_1$, narrative final states $S_f \subset S$, target emotion curve $\langle \bar{e}_t^* \rangle$

$t \leftarrow 1$
initialize playstyle inclinations $\bar{i}_1$
**while** $s_t \notin S_f$ **do**
  present narrative state $s_t$ to the player
  collect player's narrative action $a_t$
  update playstyle inclinations $\bar{i}_{t+1}$ from $a_t$
  retrieve the relevant goal set $G_t$
  compute goal desirability $\bar{d}(G_t)$ from $\bar{i}_{t+1}$
  compute narrative candidates $\{n_j\}$ from $s_t, a_t, p$
  **for** *each* $n_j$ **do**
    retreive goal probabilities $\Pr(G_t|n_j)$
    compute emotions $\bar{e}_j$ from $\Pr(G_t|n_j)$, $\bar{d}(G_t)$
    compute deviation $\delta_j$ of $\bar{e}_j$ from $\bar{e}_{t+1}^*$
  select the minimum deviation: $j^* \leftarrow \arg\min_j \delta_j$
  select the next narrative state: $s_{t+1} \leftarrow n_{j^*}|_1$
  update the game dynamics $p$ so that $s_t \xrightarrow{a_t} s_{t+1}$
  $t \leftarrow t + 1$

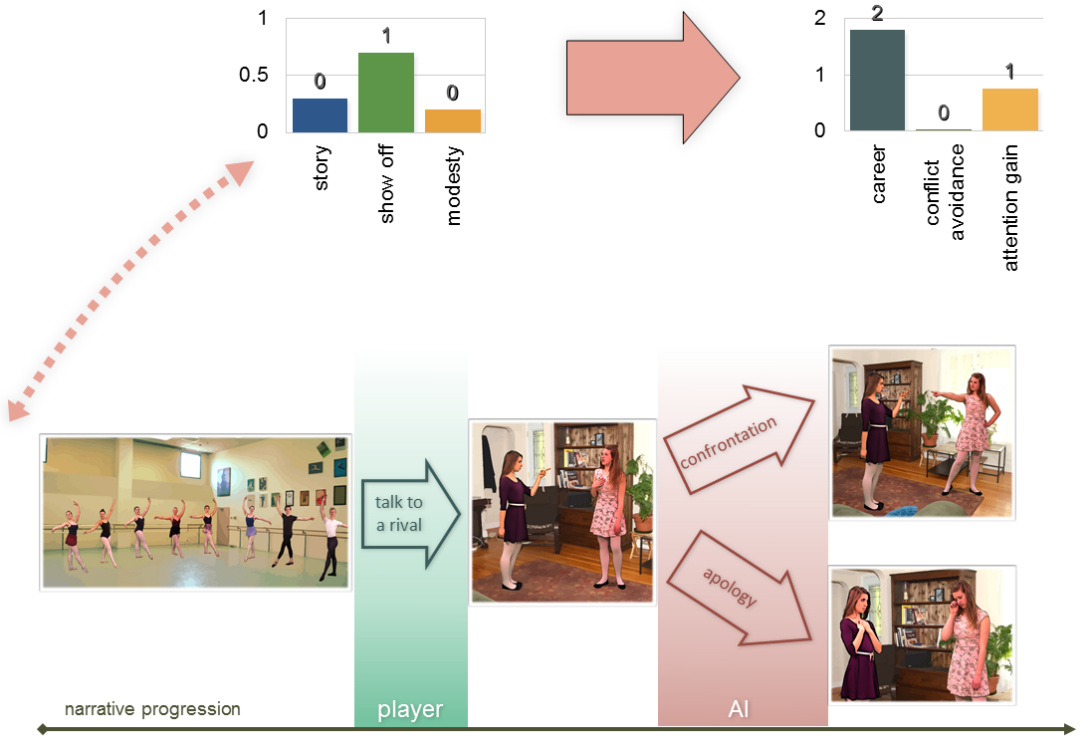


Figure 4.3: Goal desirabilities for each narrative are calculated.

### 4.2.1 Playstyles update

First the player's inclinations is initialized to different playstyles with a default inclination vector in line 2. The main loop of the algorithm (line 3) runs the story until the player arrives to one of the final narrative states: $s_t \in S_f$. Within the loop the current narrative state $s_t$ is presented to the player (e.g., "the ballet class ends") and his or her narrative input $a_t$ (e.g., "go to a party") is collected.

In line 6 the player's inclinations towards different playstyles $\bar{i}_{t+1}$ are updated:

$$\bar{i}_{t+1} = \bar{i}_t + \bar{I}(a_t) \tag{4.2.1}$$

where $\bar{I}(a_t)$ are author-supplied annotations. If any component of $\bar{i}_{t+1}$ exceeds 1 then PACE divides all of them by the maximum component.

In our example, suppose there are three archetypal playstyles: storytelling, showing off and being modest. The author annotates each possible player action in the story with the playstyle inclinations, these values represent what playstyle inclination would enjoy choosing that action. For example, the action `warms_up_confidently` has an inclination of $0.5, 1, 0.5$, meaning this action would be enjoyed the most by a player who likes to show off (1), and is undecided on whether to being modest (0.5) and following the story (0.5). PACE calculates the delta by which to change the player model by calculating the difference between this annotation and the current player model, and it multiplies this difference by a growth factor (0.25) to find the delta. Thus, each action the player takes (line 5 in the pseudocode) is used by PACE to update the player model (line 6). In the example, suppose the present value of the player model is $\bar{i}_{t+1} = (0.3, 0.7, 0.2)$.

### 4.2.2 Goal desirability

PACE then retrieves the set of goals $G_t$ the player may be pursuing at this point in the story (e.g., $G_t = \{$maintaining a successful career, leading a fulfilling personal life$\}$). In line 8 it computes the desirability $\bar{d}(G_t)$ of these goals using the updated inclinations $\bar{i}_{t+1}$:

$$\bar{d}(G_t) = \bar{d}(G) \times \bar{i}_{t+1} \tag{4.2.2}$$

where $\bar{d}(G)$ is the author-supplied matrix linking playstyle inclinations to the goals.

PACE then engages an automated planner (line 9) to compute possible narratives $\{n_j\}$ that follow the current narrative state $s_t$ and the player's action $a_t$.

Each narrative $n_j$ is a sequence of possible future narrative states. Each candidate narrative $n_j$ is evaluated as follows. In line 11 PACE retrieves author-supplied probabilities of reaching the goals from the set $G_t$ given the narrative $n_j$. It then uses the appraisal model to compute the emotional intensities $\bar{e}_j$ (line 12) given the goal desirabilities $\bar{d}(G_t)$ and the probabilities $\Pr(G_t|n_j)$ of the narrative $n_j$ allowing the player to achieve these goals (Figure 4.4).

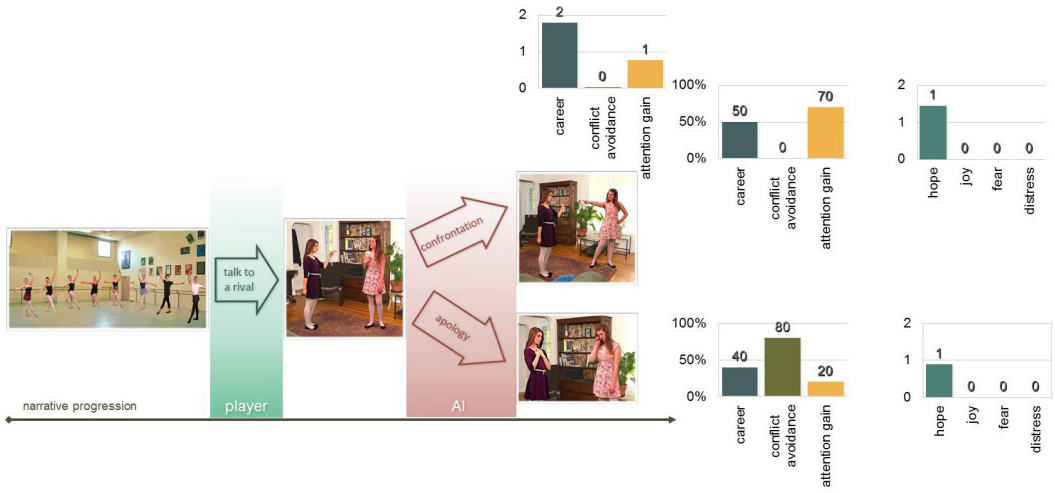


Figure 4.4: Emotion values are calculated for each narrative.

Given the player model (Subsection 4.2.1), PACE infers how desirable certain narrative goals are to the player. In the example, suppose the author previously identified three goals a player may pursue: maintaining a successful career, avoiding conflict and gaining attention. The author also provided a mapping between the playstyle inclinations and the goal desirabilities. Using the mapping and the player model computed in step one, PACE computes the desirability of the three goals as $\bar{d}(G_t) = (1.79, 0.03, 0.76)$ in line 8 (Figure 4.3).

### 4.2.3 Appraisal emotion modeling

PACE uses the previously calculated goal desirabilities and author-supplied probabilities of reaching these goals from each of the candidate narratives to predict the player's emotional response.

As mentioned in the related work section, PACE uses the appraisal emotion model. This model computes an agent's emotions by appraising the agent's goals with the likelihood that those goals will be achieved. When determining the agent's goals, it uses both desirable and undesirable goals, since each elicits different emo-

tions. For example, if a desirable goal seems to be likely to be achieved then the emotion of hope is elicited, but if the goal is undesirable the emotion elicited is the one of fear. Four emotions are modeled in this approach:

- *Hope* is elicited when accomplishing a desirable goal seems likely.
- *Joy* is elicited when accomplishing a desirable goal is certain.
- *Fear* is elicited when accomplishing an undesirable goal seems likely.
- *Distress* is elicited when accomplishing an undesirable goal is certain.

Calculation of the intensity of each emotion is done similarly to the *Culture-Emotion MAtrix* (CEMA) (Bulitko et al., 2008). Each goal the agent has will feed an emotion, depending on its desirability, expressed as an integral number and the likelihood of the goal being achieved, expressed as a percentage. Both values are multiplied and then all intensities for a single emotion are added.

Desirable goals elicit hope and joy. Undesirable goals elicit fear and distress are represented with a negative desirability value. The intensity of an emotion is the product of the goal desirability/undesirability and the probability of reaching that goal. The intensity of each emotion elicited by the narrative $n_j$ is calculated as the sum of the emotion intensities for different goals from the set:

$$e_{\text{hope}} = \sum_{\substack{g \in G_t, \\ d(g)>0, \\ \Pr(g|n_j)<1}} \Pr(g|n_j) d(g). \tag{4.2.3}$$

$$e_{\text{joy}} = \sum_{\substack{g \in G_t, \\ d(g)>0, \\ \Pr(g|n_j)=1}} \Pr(g|n_j) d(g) = \sum_{\substack{g \in G_t, \\ d(g)>0}} d(g). \tag{4.2.4}$$

$$e_{\text{fear}} = - \sum_{\substack{g \in G_t, \\ d(g)<0, \\ \Pr(g|n_j)<1}} \Pr(g|n_j) d(g). \tag{4.2.5}$$

$$e_{\text{distress}} = - \sum_{\substack{g \in G_t, \\ d(g)<0, \\ \Pr(g|n_j)=1}} \Pr(g|n_j) d(g) = - \sum_{\substack{g \in G_t, \\ d(g)<0}} d(g). \tag{4.2.6}$$

The emotions predicted to be elicited by the narrative $n_j$ form $\bar{e}_j = (e_{\text{distress}}, e_{\text{fear}}, e_{\text{hope}}, e_{\text{joy}})$. PACE can then compute the deviation of the predicted emotions $\bar{e}_j$ from the target emotion state $\bar{e}^*_{t+1}$ in line 13 as:

$$\delta_j = \|\bar{e}_j - \bar{e}^*_{t+1}\| \tag{4.2.7}$$

where $\|\|$ is the 2-norm distance: $\|\bar{a} - \bar{b}\| = \sqrt{\sum_i (a_i - b_i)^2}$.

In our example if the confronting-a-rival narrative is chosen, the probability of reaching the goal of a successful career is 50%. The probability of avoiding a conflict will be 0% and the probability of gaining attention will be 70%. The alternative narrative that sees Giselle apologize to Beatrice predicts the player's chances of having a successful career at 40%, avoiding conflict 80% and gaining attention 20%. PACE estimates the intensity of the emotions elicited in the player by each candidate narrative. For the sake of brevity we limit the example to the emotion of hope which, for the confront-a-rival candidate narrative, is predicted to have the intensity of 1.45 (line 12). The alternative narrative is predicted to elicit the emotion of hope with an intensity of 0.89 (Figure 4.4).

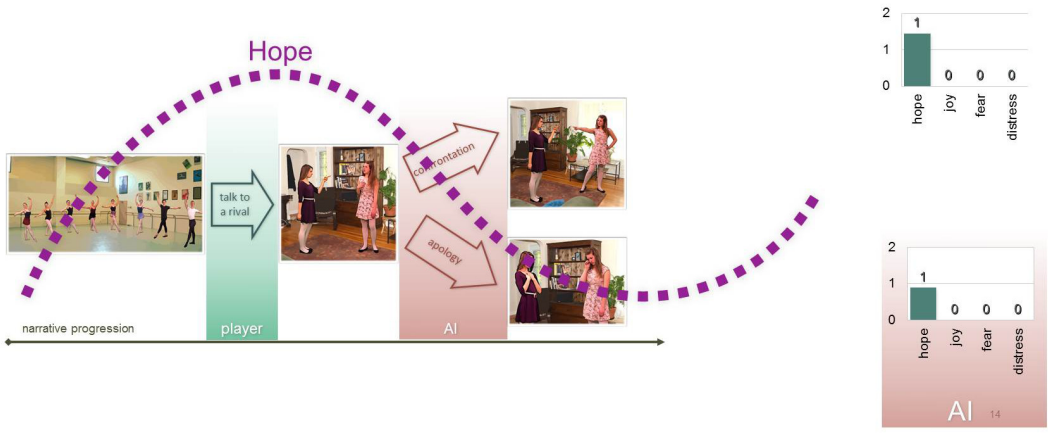


Figure 4.5: PACE selects "apology" narrative segment to keep the player close to a target emotion curve for the emotion of hope.

### 4.2.4 Narrative selection

Once the candidate narrative that minimizes the deviation from the target emotion curve is selected (line 14), PACE sets its first state as the next narrative state to be presented to the player (line 15). Following the GEM framework, PACE modifies the MDP transition function $p$ so that the player's action $a_t$ leads her from the

narrative state $s_t$ to the first state of the chosen narrative: $s_{t+1}$ (line 16). In the example above, the MDP transition function is modified by PACE so that when the player chooses to go to a party, she will end up apologizing to her rival upon arriving there.

For our example suppose the author specified that at the current point of the story a player should have an intensity of hope of 0.8 (Figure 4.5). Then the best narrative to present to the player is apologize-to-rival since its predicted value of hope intensity (0.89) is closer to the target 0.8 than the alternative (1.45) (line 14). The first state of the chosen narrative (line 15) is then presented to the player by modifying the game dynamics (line 16).

# Chapter 5

# Implementation

In this chapter we present the details of the implementation of the PACE algorithm. We will first describe how PACE is implemented by utilizing and extending existing software. We will then describe *iGiselle*, an original video game we developed to evaluate PACE.

## 5.1 Implementational Details

While reusing elements of PAST, we replaced its automated planner, *Longbow*, with a domain-independent, PDDL-compatible planner. Switching to the *de facto* standard domain description language PDDL allowed us to take advantage of recent advances in automated planning research. We used *Fast Downward* planner (Helmert, 2006). This planner was chosen because of its versatility and performance as it won the Sequential Optimization track and was the runner-up in the Sequential Satisficing track in the 2011 International Planning Competition (Coles et al., 2012).

The planner is guided by a heuristic function which PACE computes as the deviation $\delta_j$ of the emotions solicited by a candidate narrative $n_j$ and the target emotion state. Thus, the planner is able to compute the best narrative $n_{j^*}$ without explicitly computing all alternatives $\{n_j\}$. The planner is invoked in two cases: (i) the player chose an action that introduces a rupture, (ii) PACE appraises the player's current emotions to be different from the target emotion state. A rupture (Riedl et al., 2008) is any action done by the player that would cause the game world to be inconsistent with the rest of the current narrative (e.g., the player decides to confront her rival in the party whereas the current narrative would have the player ignoring her). In the first case, ruptures are detected by checking if the preconditions of the next event, in the current narrative, to be presented to the player are not met.

Following our previous example of the player confronting her rival, this event would introduce the condition of `confronted rival` and the following event in the current narrative has as a precondition `not (confronted rival)` which is expressing that `confronted rival` should not be part of the domain in order for this event to take place. For the second case PACE utilizes line 9 in Algorithm 1 determines if the player's current emotions are different from the target emotion state, if so the planner is invoked.

### 5.1.1 PDDL

The Planning Domain Definition Language (PDDL) is a commonly used description planning language (Ghallab et al., 1998). This language is used by all planners developed for the International Planning Competition, so adopting it for PACE allows it to be compatible with the planners submitted to the competition.

To illustrate, Figure 5.1 shows the encoding of the action `dances`, which has four parameters: `p1, p2, p3` and `p4`. The precondition block contains the facts needed to be present in the current state in order for the action to be applicable to it. In the example, `p1, p2, p3` and `p4` need to be persons and alive; `p1` is the protagonist (the character controlled by the player), `p4` is a teacher, `p3` is a friend, `p2` is a rival, `p4` is not impressed so far and `p1` has a contract. The effect block contains the facts that will be added to the domain once the action is executed. Continuing with the example, after the action executes `p4` is impressed.

In *iGiselle* the action may apply as follows: `p1` is Giselle, `p2` is Beatrice, `p3` is Henry and `p4` is Albert, this action happens during the first classes in the story and the result is that Albert is impressed with Giselle `(impressed Albert)`. The `increase (total-cost)` block is used to pass to the planner the likelihoods of achieving each goal from this action. In our current implementation we know when each action will take place in the story, therefore it is possible to know what the likelihood of each goal being achieved is for each of the actions encoded. In this example there is a 70% likelihood of achieving the first goal while there is a 0% likelihood of achieving the other two. The conversion from `70000000` to the goal likelihoods is as follows: starting from the least significant digit the number is separated into 3 digit segments (`70 | 000 | 000`). Then each segment is converted into the goal percentage (70%, 0%, 0%). If there are fewer segments than goals, any remaining goals have a percentage of 0%.

```
(:action dances
:parameters (?p1 ?p2 ?p3 ?p4)
:precondition (and (person ?p1) (person ?p2) (person ?p3) (person
?p4) (alive ?p1) (alive ?p2) (protagonist ?p1) (teacher ?p4) (friend
?p3) (alive ?p3) (alive ?p4) (rival ?p2) (not (impressed ?p4))
(contract ?p1))
:effect (and (impressed ?p4) (increase (total-cost) 70000000)))
```

Figure 5.1: A ballet action encoded in PDDL.

### 5.1.2 Fast Downward

*Fast Downward* is a heuristic-based planner used by PACE within *iGiselle*. The heuristic is used in the search component of the planner. Where the planner utilizes search algorithms (which ones and how many can be configured by the user) in order to do the actual planning. The heuristic is used by the search algorithms in order to obtain the optimal plan efficiently. It supports deterministic planning problems encoded in PDDL. *Fast Downward* is a progression planner, searching the space of world states of a planning task in the forward direction. In PACE within *iGiselle*, we set *Fast Downward*'s heuristic to be the Euclidian distance between the current plan's emotion states and the author-specified emotion trajectory. In order to calculate the heuristic the planner uses PACE's emotion appraisal to determine what the player's emotion state will be if presented the current plan. PACE provides the planner with all the necessary information it previously calculated: current playertype model, the goal desirabilities for that model, the author-specified emotion trajectory, current state of the world in PDDL form, the goal state of the world. With this information and the goal likelihoods encoded in the PDDL statements, the planner can calculate the emotion trajectory of the plan and evaluate if it is the closest to the author-specified trajectory (Algorithm 1, lines 9 - 14). The total cost of the plan is the sum of the Euclidian distances between the events in the plan and the author-specified emotion.

## 5.2 Implementation of PACE in *iGiselle*

To evaluate PACE, we developed a game testbed called *iGiselle*: an interactive version of the Romantic ballet Giselle (Gautier et al., 1841). In *iGiselle* the player takes control of the titular character and experiences the narrative through a series of still images, voice overs and music. To further immerse the player in the world


Figure 5.2: *iGiselle* game interface. The player makes his/her narrative choice by assuming one of the three positions shown on the left. The player's current position in visualized with a stick figure in the bottom left window.

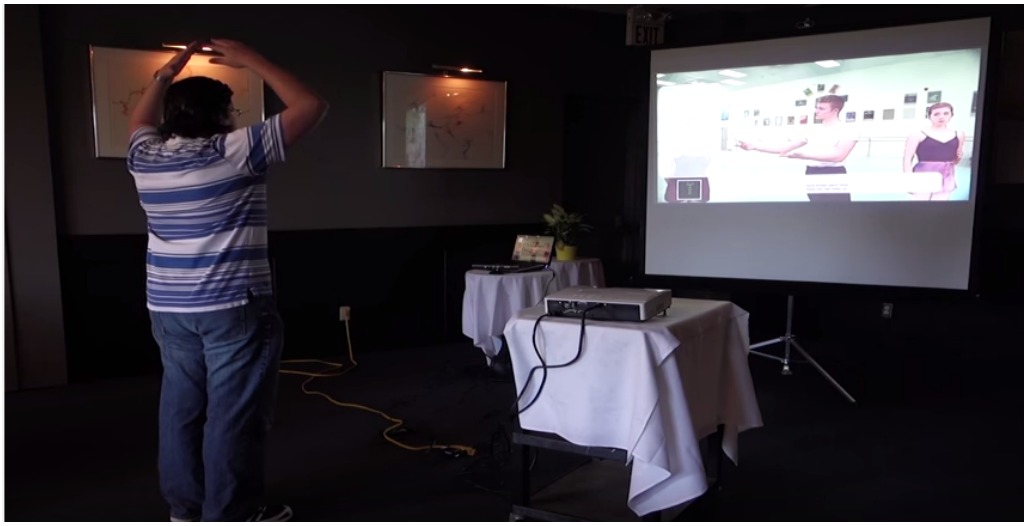

Figure 5.3: Playing *iGiselle*.

of ballet, we forwent a traditional game controller and had the player indicate their narrative choices by assuming dance positions (Figure 5.2) which were then read with Microsoft Kinect (Figure 5.3).

Figure 5.4: *iGiselle* scene creation stages. Left: a capture session. Center: a green-screen photograph. Right: the processed image.

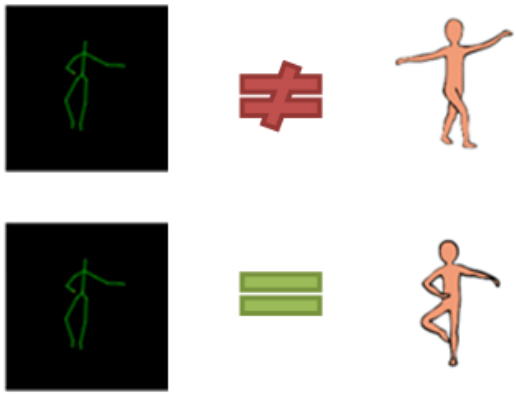

Figure 5.5: Example of pose recognition. Top image shows that the current pose (skeleton outline on the left) does not match the sample picture (figure on the right). Bottom image shows that the current pose does match the sample picture.

The multimedia content was developed in two phases. First, working with various writers we constructed a non-linear narrative graph which allows the player to explore various narratives via choices they make during the game. The story contained 102 narrative events and 4 choice points which resulted in 9 distinct narrative trajectories and 10 possible endings (Appendix A). In phase two, we worked with ballet dancers and choreographers, voice actors and recording engineers, photographers and graphic artists to create 162 cell-shaded images (Figure 5.4) (Appendix D) and 270 lines of voice overs (Appendix B).

The narrative graph was encoded as states and actions in PDDL, in order for PACE to be able to generate candidate narratives (line 9 in the pseudocode). The game interface was coded in C# and linked to the Kinect framework (Microsoft, 2013). We implemented a pose recognition module to read in the player's poses and

interpret them as narrative choices. (Figure 5.5). In total, there were 44 people involved in *iGiselle* production which took approximately a year and a half.

# Chapter 6

# Empirical Evaluation

We evaluated PACE with two user studies. In the first user study we compared the feelings of fun, agency and believability subjects felt while playing *iGiselle* with PACE enabled and disabled. In the second user study we used the same setup but asked participants to compare their experience playing *iGiselle* with another game, PAST. In both studies we used a version of *iGiselle* that does not require the Kinect sensor and is instead controlled with a mouse and keyboard. This was necessary since we were unable to acquire enough Kinect hardware to run the studies in a reasonable amount of time.

## 6.1 User Study 1

In the first user study there were 294 participants (mean age 19; 148 females, 146 males). For their participation they received a partial course credit for an undergraduate psychology class in which they were enrolled. The participants were divided into two conditions: experimental (149 participants) and control (145 participants). In the experimental condition the subjects played *iGiselle* with their in-game experience managed by PACE. The control condition was the same except PACE was using a random player model. This was done by disabling line 6 in Algorithm 1 and fixing the inclinations to the final values obtained from a randomly selected participant in the experimental condition. Such setup is known as *yoking* and is meant to approximately equalize the coverage of the player model space in both conditions (Ramirez Sanabria and Bulitko, 2014).

Upon completing a game in approximately 40 minutes each participant was directed to fill out a questionnaire to rate his or her *iGiselle* experience. In line with previous work (Thue et al., 2011; Ramirez Sanabria and Bulitko, 2014), we used an

existing validated instrument for measuring the player's feelings of agency, fun and believability (Vermeulen et al., 2010). Sample questions are listed in Figure 6.8. The participants reported how much they agree or disagree with each statement on the scale of 1 through 5. Each question was related to one of three categories (the player's feelings of agency, fun and believability). Each category score is the sum of answers to its questions divided by the category's maximum score. The full survey consists of 22 questions (Appendix E).

### 6.1.1 Outlier removal

Using the scores we analyzed the data for any outliers using the ESD Discordancy test, with the Mahalanobis distance of each data point as the outlier statistic (Zijlstra et al., 2011). In our case each data point represents the three scores (agency, fun and believability) given by a single participant. A common practice for detecting outliers is to calculate the Euclidean distance along one dimension of the data. This works well when one analysis a single variable but can lead to false positives given multiple variables. We used Mahalanobis distance which is meant to remedy this problem.

Once we calculated the Mahalanobis distance from each point to the rest of the data points, we used ESD testing to determine whether a data point is an outlier. The process worked as follows. We ordered the data points from lowest distance to highest. We divided the data by half and used as non-outliers the half containing the lowest distances. For each point in the half with the largest distance, we calculated its ESD until we got to a point that is over the given threshold, all points beyond this point are outliers.

To illustrate this procedure we will apply it to the following synthetic data set consisting of six data points (three values each):

$$\begin{aligned} \bar{x}_1 &= (34, 21, 15), \\ \bar{x}_2 &= (34, 20, 15), \\ \bar{x}_3 &= (29, 17, 14), \\ \bar{x}_4 &= (33, 22, 15), \\ \bar{x}_5 &= (29, 30, 19), \\ \bar{x}_6 &= (15, 30, 12). \end{aligned} \tag{6.1.1}$$

First, we calculate the Mahalanobis distance for each point to the rest of them as:

$$D_M(\bar{x}_i) = \sqrt{(\bar{x}_i - \bar{\mu})^T S^{-1} (\bar{x}_i - \bar{\mu})} \tag{6.1.2}$$

where $\bar{x}_i$ is the data point, $\bar{\mu} = (29, 23.33, 15)$ and $S$ is the covariance matrix of the data:

$$\begin{bmatrix} 52.4 & -25.4 & 8.4 \\ -25.4 & 29.4667 & 2.6 \\ 8.4 & 2.6 & 5.2 \end{bmatrix}. \tag{6.1.3}$$

The distance for each data point as $(1.03, 0.65, 4.04, 0.94, 4.16, 4.14)$.

Next, we order the data points from shortest distance to longest and divide the data points, with their respective distances, into two sets. The low-distance half, which are the non-outliers:

$$\begin{aligned} \bar{x}_2 &= (34, 20, 15), \quad D_M(\bar{x}_2) = 0.65, \\ \bar{x}_4 &= (33, 22, 15), \quad D_M(\bar{x}_4) = 0.94, \\ \bar{x}_1 &= (34, 21, 15), \quad D_M(\bar{x}_1) = 1.03 \end{aligned} \tag{6.1.4}$$

and the high distance half, which are the outlier candidates:

$$\begin{aligned} \bar{x}_3 &= (29, 17, 14), \quad D_M(\bar{x}_3) = 4.04, \\ \bar{x}_6 &= (15, 30, 12), \quad D_M(\bar{x}_6) = 4.14, \\ \bar{x}_5 &= (29, 30, 19), \quad D_M(\bar{x}_5) = 4.16. \end{aligned} \tag{6.1.5}$$

No further analysis is done to the non-outliers groups, but they are used to determine the parameters required to process the outlier candidates. We apply the ESD testing to each datapoint in the outlier candidates group until we get a value higher than a threshold, in line with previous work in the field (Zijlstra et al., 2011) we use 2.58, or there are no more candidates to evaluate:

$$\text{ESD}(\bar{x}_i) = \frac{|D_M(\bar{x}_i) - avg(D_M)|}{S_{D_M}}. \tag{6.1.6}$$

Here $avg(D_M)$ is the mean of the non-outliers' distance and $S_{D_M}$ is the standard deviation of the non-outliers' distance, in our example $avg(D_M) = 0.89$ and $S_{D_M} = 0.18$. Evaluating the first outlier candidate ($D_M(\bar{x}_3) = 4.04$), $\text{ESD}(\bar{x}_3) = 17.4925$ which is higher than the threshold 2.58 so it is determined that all remaining candidates are outliers.

Outlier detection was done individually for the control and experimental conditions. Following this process, the answers of 11 participants in the control condition and 7 in the experimental condition were deemed outliers and removed from further analysis. In line with previous work in the field (Ramirez Sanabria and Bulitko, 2014), the remaining data points were further split by gamer and non-gamer based on the average gaming hours per week each participant reported. We used the same values as previous work, deeming a participant to be a gamer when he/she played at least an hour a week.

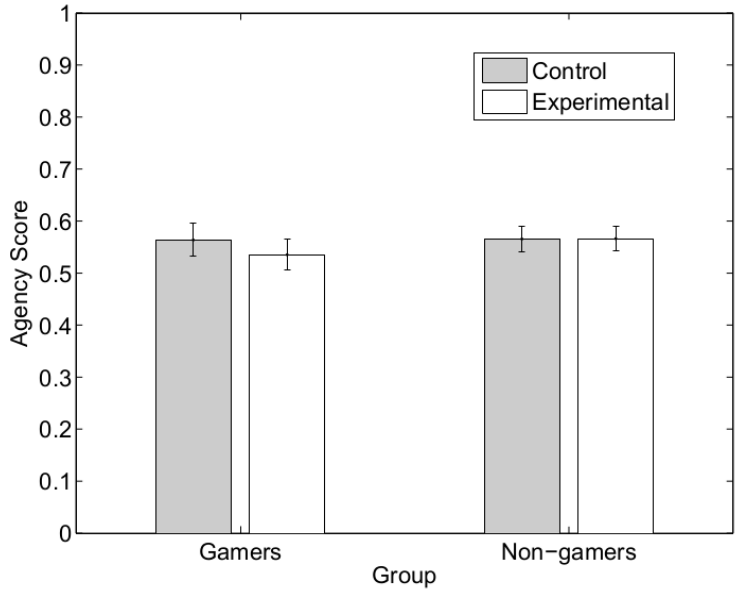


Figure 6.1: Agency results for User Study 1.

Table 6.1: Results for User Study 1.

| **Player Type** | **Agency** | | **Fun** | | **Believability** | |
|---|---|---|---|---|---|---|
| | Control | Exp. | Control | Exp. | Control | Exp. |
| Gamer | 0.5637 | 0.5353 | 0.3472 | 0.3658 | 0.5980 | 0.5996 |
| Non-Gamer | 0.5658 | 0.5663 | 0.3722 | 0.3833 | 0.6009 | 0.6386 |

### 6.1.2 Results

Table 6.1 reports mean category scores. The mean score for fun is higher for the experimental condition for both gamers and non-gamers. The believability is higher for non-gamers. Neither difference is statistically significant as indicated by a one-way MANOVA ($p > 0.4$ for both gamers and non-gamers) (French et al., 2002).

The lack of statistical significance in Study 1 may be due to a high variance in the participants' backgrounds. For instance, when answering the question "The story experience was interesting" the participants may have different baselines to compare their *iGiselle* experience to. In deciding exactly what "interesting" is, some participants may compare their *iGiselle* narrative experience to a recent commercial video game they played while others may compare it to a fan-fiction story. This led us to design and run another study.

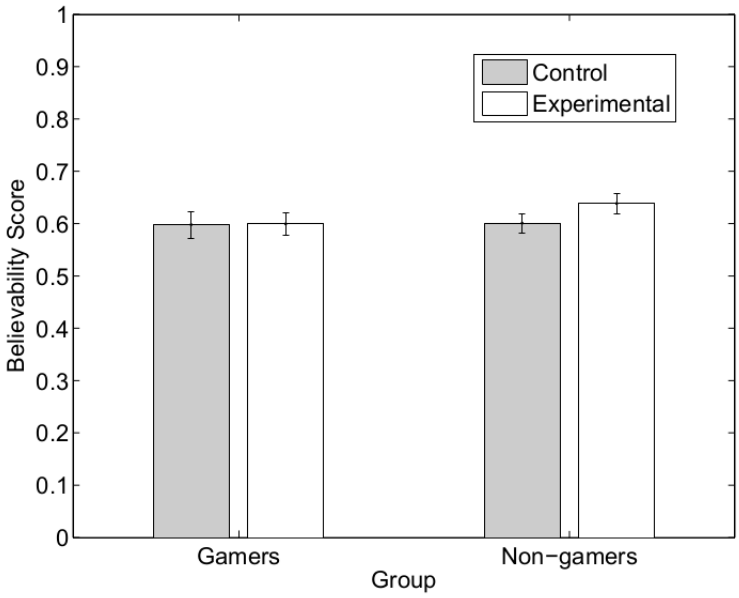


Figure 6.2: Believability results for User Study 1.

## 6.2 User Study 2

In an attempt to make the participants' responses more compatible, we ran another user study which used the same two conditions as the first study but had all participants play another game before playing *iGiselle*. Then the survey questions were modified so that the 1-5 ratings of *iGiselle* experience would be relative to that game (Figure 6.4). We chose PAST (Ramirez Sanabria and Bulitko, 2014) for the calibrating game as it was an interactive narrative experience (albeit without the multimedia of *iGiselle*) and we were granted access to it by its developers.

Due to the timing of this study we were able to recruit only 39 participants (mean age 20; 23 females, 16 males). For their participation they received a partial course credit for an undergraduate psychology class which they were enrolled in. The participants were divided into two conditions: experimental (19 participants) and control (20 participants) which were identical to Study 1 except that they played PAST before *iGiselle* and answered the modified survey questions.

We used the same data analysis procedure. There was only one outlier in the control group. The results are found in Table 6.2. The mean values for agency and fun are higher in the experimental condition for non-gamers. All the other values for the experimental condition are below the control condition. However, none of the differences reached statistical significance according to the MANOVA ($p > 0.1$

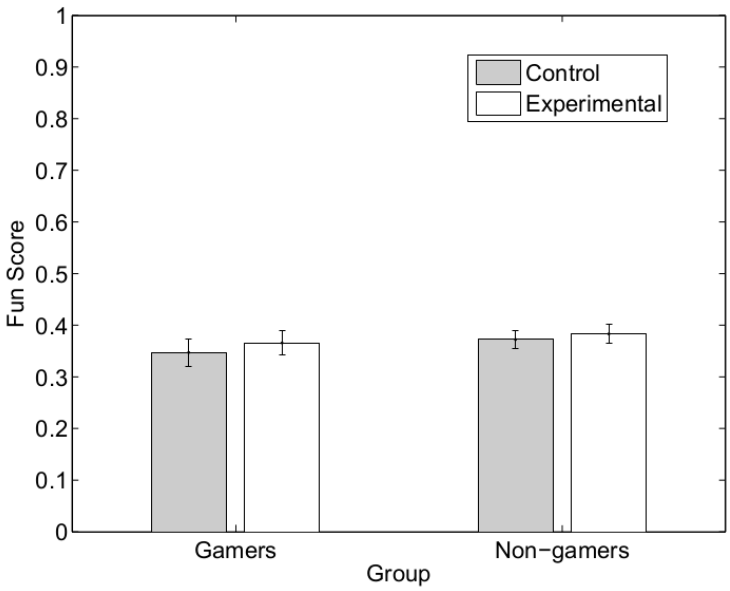


Figure 6.3: Fun results for User Study 1.

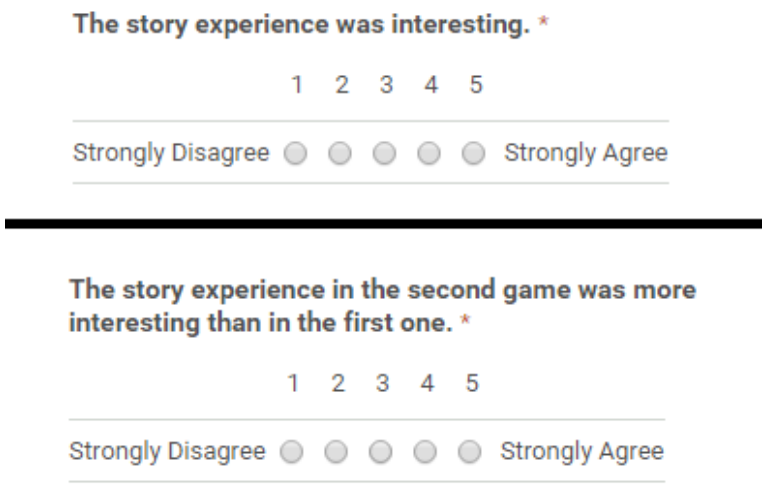


Figure 6.4: Question difference between study 1 (top) and study 2 (bottom).

for both gamers and non-gamers).

Table 6.2: Results for User Study 2.

| Player Type | Agency | | Fun | | Believability | |
|---|---|---|---|---|---|---|
| | Control | Exp. | Control | Exp. | Control | Exp. |
| Gamer | 0.5476 | 0.3988 | 0.3006 | 0.2560 | 0.6161 | 0.5179 |
| Non-Gamer | 0.5160 | 0.6250 | 0.3333 | 0.4394 | 0.6827 | 0.6534 |

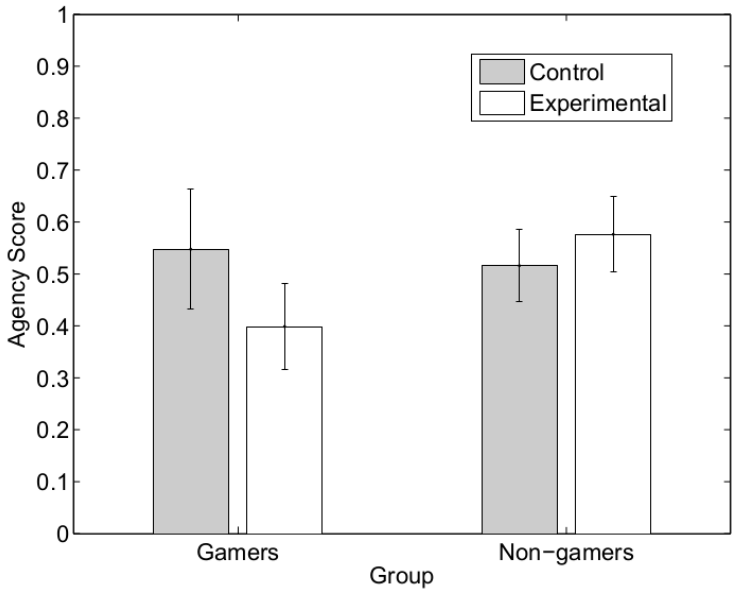


Figure 6.5: Agency results for User Study 2.

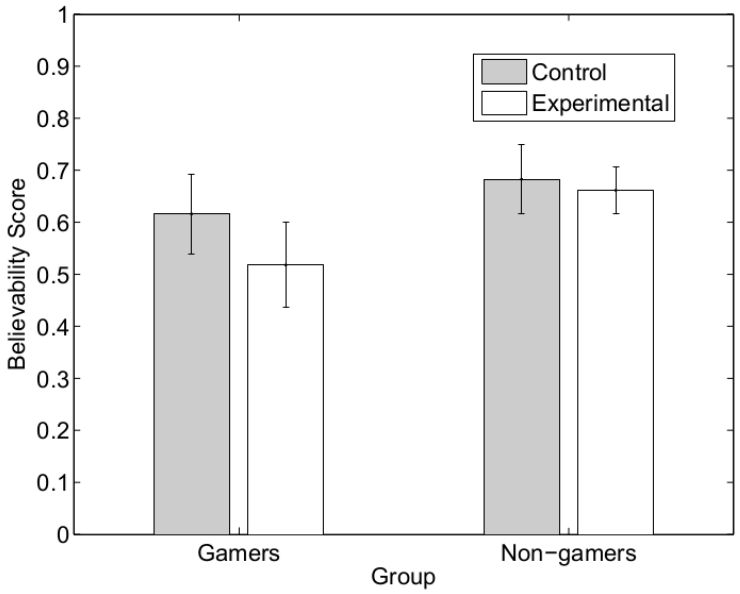


Figure 6.6: Believability results for User Study 2.

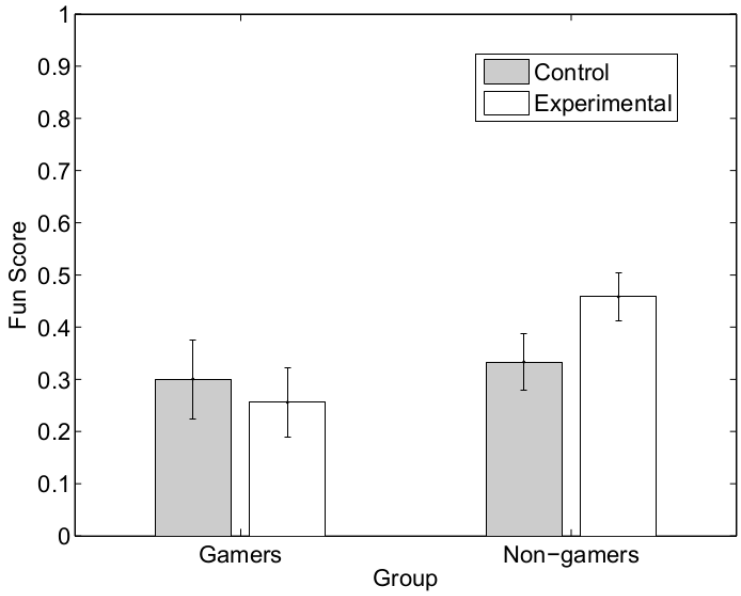


Figure 6.7: Fun results for User Study 2.


Figure 6.8: Sample questions from the user study survey.

# Chapter 7

# Discussion and Future Work

There is currently no statistically significant evidence that the implementation of PACE in *iGiselle* solves our original problem. While some of the results show promise, they are not conclusive. We conjecture that Study 1 may have had the participants comparing their *iGiselle* experience to different prior experiences. Study 2 introduced a common experience to compare *iGiselle* to but may have suffered from the low number of participants.

The inconclusive results may also be caused by the various data provided by the author: the emotional curve, playstyle categories, goal desirabilities, goal likelihoods and the story domain. These data have not been externally validated. For example, it could be that the playstyle categories used in *iGiselle* are do not fit the story, or the playstyle updates from the player's actions may be incorrect. It can also be that the difference between the nine distinct narrative trajectories a player can experience in *iGiselle* turned out somewhat subtle and may have been missed by some players. For instance, at one point of the story Albert, the ballet director, proposes to Giselle. The player is then presented with three options for Giselle: accept happily, ask for some time to think about it or accept hesitantly. Some participants may not have realized that their answer actually affected the later story, especially as each participant experienced *iGiselle* only once. Further user studies will need to be set up in order to determine what combination of the factors mentioned above caused the inconclusive results.

## 7.1 Future Work

While the narrative of *iGiselle* does have diverging paths, they are few, during the initial scenes and converge into a single narrative (Appendix A). Also the changes

to the story are subtle and might go unnoticed to the player. This is also difficult to evaluate the impact they had on the player. A re-structuring of the story (or a completely new one) to add more distinct narrative paths may be helpful. Also, in order to confirm the results regarding the fun score among non-gamers, a larger subject pool for Study 2 should be used to determine if the results have a statistical significance.

As implemented in *iGiselle*, PACE requires the author to manually specify a mapping from the playstyle inclinations to goal desirability as well as probabilities of achieving various goals given a candidate narrative. Not only is this labour-intensive but the provided values may not be valid. Future work will attempt to procedurally generate some of those parameters. For instance, Monte Carlo rollouts can be used to predict probabilities of achieving a goal.

Finally, PACE could be implemented to include a goal-detection mechanism. Currently, the author needs to input the values for the goal likelihood for each story event which may introduce errors in the system if the author's evaluation of each goal is erroneous. An evaluation of automated methods for computing goal achievement likelihood needs to be carried out in order to determine their suitability to PACE.

# Chapter 8

# Conclusion

The problem we set out to solve at the start of this project was to enhance the player's playing experience, increase his/her sense of fun, agency and believability, by keeping his/her emotions close to an author specified emotion curve. Our solution was to create an experience manager that took as an input the player's current emotion state, compared that to the emotions the author specified and output a narrative that would ellicit the emotion from the player.

In this work we have made the following contributions. First, we created PACE, an AI experience manager that can be used in an interactive story setting where the player's actions affect the story progression while attempting to keep him/her on an author-provided emotional trajectory. Second, we implemented PACE within a novel videogame *iGiselle* that we also developed. Third, we ran two user studies to evaluate whether PACE increased the feeling of fun, believability and agency. While the results were not statistically significant they did show promise and opened directions for future work.

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# Appendix A

# iGiselle plot structure

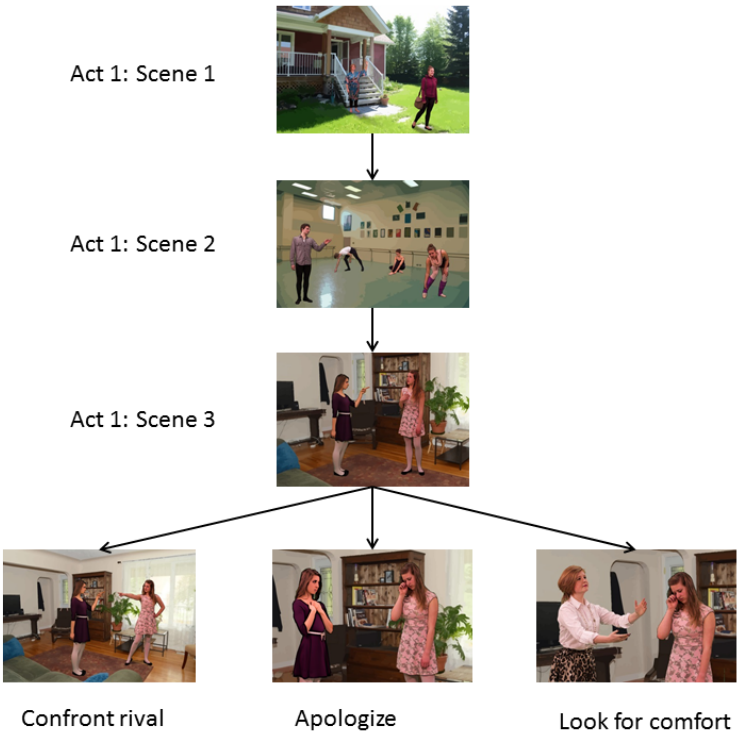


Figure A.1: *iGiselle* story structure (Part 1).

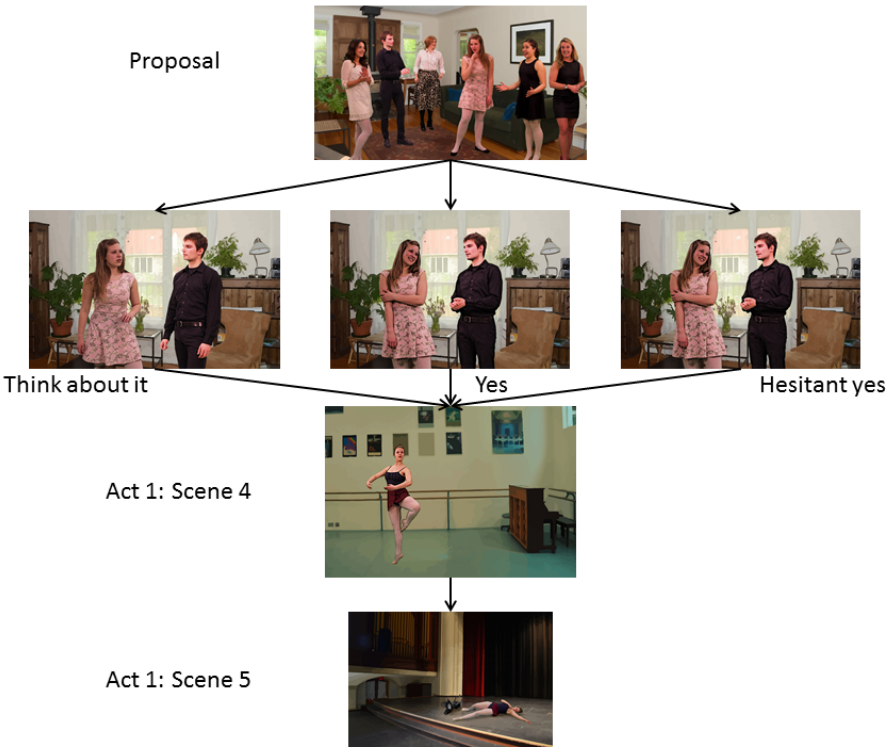


Figure A.2: *iGiselle* story structure (Part 2).


Figure A.3: *iGiselle* story structure (Part 3).


Figure A.4: *iGiselle* story structure (Part 4).

# Appendix B

# iGiselle script

## B.1 Characters

**Giselle** is a young impressionable dancer who has always worked to do her best in dance. She is close with her mother but they have a complicated relationship. Giselle wants to please her mother since she always worked hard to give her daughter the best she could. Giselle falls for Albert and eventually discovers he has betrayed her.

**Betty** was a dancer too but never made it as far as Giselle (lives vicariously). Betty wants Giselle to succeed as a dancer and feels the renowned Albert can help her achieve this goal. Giselle is talented but not as focused as Betty would like, Beatrice is the determined type Betty would have wanted Giselle to be.

**Beatrice** is prideful and was the best dancer in the company. Beatrice takes her career very seriously and secretly has feelings for Henry (but is more focused on her dance career). She is mean toward Henry, condescending and judgemental but occasionally friendly. Beatrice dislikes Giselle especially after Giselle gets the lead role Albert had promised her.

**Henry** knew Giselle from childhood and he is happy to have her in the same company. He has strong feelings for her. Henry is a good dancer and has always worked hard. He wants everything to be 'fair' and believes that if he does his best, good things will come. He hopes to win Giselle's heart now that she is closer to him.

**Albert** is impetuous, impulsive and egotistical. He 'defected' from a successful company where he was a big star but wants to make it on his own to prove himself to the world. Albert is now having financial problems with the company and this is alluded to via overdue bills and his temper on the phone but Giselle has no idea (until she's an all-seeing ghost). He falls for Giselle and puts a lot of faith in her. He believes she can fix all his problems and she seems willing to do so (she loves him and is dedicated to helping him). Albert is in denial about his real issue of being too proud to ask for help and not taking good advice when it is offered to him.

**Myrtha and the Wilis**. Giselle has a nightmare in which she is haunted by Myrtha. When she falls into a coma Giselle meets the Wilis and Myrtha (again). Myrtha represents the forces in Giselle's life that she is trying to contend with. Giselle has issues standing up to her mother, and also feels a strong need to please Albert, her new love and boss. Myrtha conveys these traits by being both caring toward Giselle and overbearing, pushing her to dance endlessly with the other Wilis in manipulative ways. Myrtha's character messes with Giselle psychologically by trying to convince her that her friends and family do not really have her best interests at heart. Wili 1: Marie (inspired by Taglioni). Wili 2: Carla (inspired by Carlotta Grisi, the first Giselle).

## B.2 Story

### B.2.1 Brief Summary

Giselle joins a new dance company that the director Albert has recently launched. Giselle and Albert fall for each other much to the dismay of Henry and Beatrice. Beatrice was promised the lead role that is now Giselle's. Henry is suspicious of Albert and thinks Giselle deserves better. Giselle is under a lot of pressure to succeed in the lead role and wants to please Albert and her mother even though they demand a lot from her. Giselle suffers an injury while practicing alone early one morning and ends up in a comatose state where she meets Myrtha and the Wilis. Myrtha seems kind at first but is ultimately trying to convince Giselle to take revenge on someone close to her because they are responsible for her accident. Giselle must decide if she should take revenge or stand up against Myrtha and the Wilis.

### B.2.2 ACT 1 - Scene 1

NARRATOR: Giselle is an aspiring young dancer who lives with her mother, Betty. Both are excited about Giselle's first day at a new ballet company called Valiance Dance led by a promising new artistic director, Albert Albertson.

GISELLE: "See you after class, Mom!"

BETTY: "Good luck, Giselle. Make me proud. Don't overdo it, dear, remember your heart condition."

GISELLE: "I know, Mom. Love you."

BETTY: "Just remember what I taught you. Don't be shy. Make sure they like you, just be yourself..."

NARRATOR: Giselle arrives at the ballet company's studio where other dancers are warming up.

(On screen question: How do you enter the class?) A (Fighter): Walk in confidently and complete an impressive warm up sequence. B (Storyteller): Find a corner to calm your nerves and warm up, quietly. C (Method Actor): Approach the other dancers in a friendly manner and introduce yourself. GISELLE: "Hi, I'm Giselle!"

HENRY: "Giselle! I'm so happy you're here!"

BEATRICE: "Who is that?"

HENRY: "Beatrice, this is Giselle. Giselle and I have known each other since we were little kids."

BEATRICE: "Oh, hi. Welcome to the company. Hope you can keep up."

NARRATOR: Albert enters the room and everyone takes their place at the ballet barre. He leads the class and notices Giselle's talent.

ALBERT: "Tendu and one and two and three." "Arabesque." "Point your foot!!" "Faster head." "Again!" "Fifth position "Lift your head, Beatrice." "Passé." "Long arms, shoulders down!" "Balance."

ALBERT: "Great class, everyone! I would officially like to welcome the newest member of our company, Giselle Woods."

COMPANY: clapping

ALBERT: "I'd like to announce the ballet we will be working on for our spring season. As you know, I am using a lot of modern theatre technology to update old ballets. The classical, Romantic ballet, Giselle will be my world premiere."

COMPANY: clapping and tittering (record us)

ALBERT: "Giselle, I need to speak to you."

GISELLE: "Of course." (tentative)

ALBERT: "You impressed me in class today. I'm surprised."(great honour for him to say this)

GISELLE: "Thank you! I'm so happy to be here. I look forward to working with you."

NARRATOR: Giselle goes home and tells her mother about her successful day.

### B.2.3 ACT I - Scene 2

NARRATOR: The next day, Giselle arrives at the studio and encounters Beatrice in the hallway outside Albert's office.

GISELLE: "Hi, Beatrice. How are you?"

BEATRICE: "I'd be better if you weren't here." (under her breath)

GISELLE: "Pardon me? (truthful) Oh, sorry. I didn't know you were in a rush."

ALBERT: "Giselle?"

GISELLE: "Hello, Albert."

ALBERT: "So good to see you, Giselle. Come in. Let's go over your contract as a new company member."

NARRATOR: After speaking with Albert, Giselle goes to the studio to warm up for class. Albert leads the company through a ballet class and addresses the group before the dancers leave for the day.

ALBERT: "I'd like to announce casting for our production of Giselle. Henry Sterling will dance the role of Albrecht and our newest member, Giselle Woods, will dance the lead role of Giselle - a role she was born to play!"

Giselle's reaction: A- Bold/proud.self-assured "Thank you. I'm really excited to be playing the lead role."

B- Shy/startled/nervous "Oh my, I'm so surprised. I wasn't expecting this, thank you!"

C- Friendly/going-along "Thank you so much. I'm honoured to be cast in this role."

HENRY: "Congratulations, Giselle!"

BEATRICE: "What? Giselle is the lead? Oh great, I get to play the role of Bathilde."

BETTY: "Giselle! Congratulations!"

GISELLE: "Mom?"

BETTY: "I overheard the amazing news as I came in the door!"

GISELLE: "Thanks, Mom"

BETTY: "Oh, Giselle. I've just come up with a great idea! Everyone, in honour of my daughter's new role, I'd like to invite you all to a party next week. I'd love everyone to come celebrate Giselle's success and this exciting new production of the ballet Giselle."

NARRATOR: All the dancers are excited about the pre-show party announcement; except for Beatrice, who brusquely walks out of the studio.

### B.2.4 ACT 1 - Scene 3

NARRATOR: As Albert choreographs the lead role on Giselle over the next few days, the two begin to develop feelings for one another. During their private rehearsals, their professional relationship evolves into a romance.

NARRATOR: At the pre-show party hosted by Giselle's mother Betty and Giselle greet their guests, and everyone congratulates Giselle on her role.

(party background)

BETTY: "Stand up straight, Giselle. Don't eat too much. Haven't you had enough to drink?"

GISELLE: (annoyed) "I know, I heard you, mom."

NARRATOR: Betty enjoys the party with pride, but she keeps a close eye on Giselle, constantly watching to make sure Giselle doesn't embarrass her. Giselle mingles with her guests, but can't help notice Beatrice brooding in the corner of the room.

(Beatrice is lurking angrily in the shadows at the party. And hovering near Henry.)

- RUPTURE -

GISELLE: "Beatrice, you seem upset. Is something wrong?"

BEATRICE: "Be careful, Giselle. Albert made (me) lots of promises (to me) too. He said he'd make me a star, and look what he's done to me now. Don't say I didn't warn you!"

(Options to be determined by AI planner:)

A (Fighter) Giselle challenges Beatrice to a dance off (duel) and wins but this leaves Beatrice even more upset with Giselle.

GISELLE: "Albert must have chosen me for a reason. Maybe he just thought I was better suited for this role!" BEATRICE: "Let's settle this on the dance floor!" (dance off sequence of photos)

B (Method Actor) Giselle goes and cries. Betty comforts her.

GISELLE: (choked up, upset) "I didn't know I was taking the role from her! What should I do?"

BETTY: "Don't worry, sweetheart, I believe in you. Everything will be okay. I love you so much."

C (Storyteller) Giselle apologizes, and Beatrice opens up about her feelings toward Albert due to their past.

GISELLE: "I don't understand why you're so upset, Beatrice."

BEATRICE: "Albert told me I could have the lead role and I've been rehearsing every day. I thought he believed in me."

GISELLE: "I didn't know I was taking the role from you!"

BEATRICE: "It's Albert's fault for misleading me."

NARRATOR: The party continues on into the evening and before anyone leaves Albert gathers everyones attention for a special announcement.

- RUPTURE -

ALBERT: "Everyone, I'd like to have your attention. Giselle, I've decided we should get married!!" [excited]

Option 1

GISELLE: "Uh, I need to think about this. Could we talk about it later?"

(incensed, angry)

ALBERT: "Of course! Let's discuss our upcoming engagement, privately."

NARRATOR: "The party disperses and Giselle confides in her mother."

GISELLE: "How can he think I would want to get married right now?"

BETTY: "Albert is a wonderful man and a great director. You'll have a great future together."

GISELLE: "I guess I need to think about this."

Option 2

GISELLE: "How unexpected, ummm. . . .okay?"

(hesitant, reluctant yes)

NARRATOR: "After the party Giselle seeks Betty's advice about Albert's proposal."

GISELLE: "What do you think I should do, mom? He caught me off guard."

BETTY: "Albert is a wonderful man and a great director. I don't think you should go back on your word, dear. You'll have a great future together."

Option 3

GISELLE: "Yes!"

(excitedly)

NARRATOR: "After the party Giselle celebrates with her mother."

GISELLE: "Can you believe he proposed tonight? I'll be Mrs. Albertson."

BETTY: "Yes! This is exactly what I hoped for you dear!"

NARRATOR: Betty sends Giselle off to bed to get some rest while she cleans up after the party.

### B.2.5 ACT 1 - Scene 4

NARRATOR: The next day, as Giselle arrives at the Valiance Dance building, Henry storms through the hallway on his way out.

GISELLE: "Henry, is everything alright?"

HENRY: "I just don't understand what you see in him, Giselle." (a bit to himself)

GISELLE: "What did you say?" (truthfully didn't hear him)

HENRY: "Never mind."

(sound of Henry's footsteps walking away and the door slams)

GISELLE: "Albert? Albert, are you here?"

ALBERT: “Hello?” (Albert’s voice off in the distance)

GISELLE: “Oh, there you are, Albert. I was looking for you.”

ALBERT: “What do you want, Giselle? I’m very busy.” (short-tempered)

GISELLE: “Do you know what’s going on with Henry? I just ran into him storming out of the building.”

ALBERT: “Do you have any idea how much work it takes to run a ballet company? I don’t have time to concern myself with some dancer’s mood swings.”

GISELLE: “Sorry, Albert. I was just concerned about Henry”

ALBERT: “Are you really taking up my time to ask me this?”

GISELLE: “No, I just -”

ALBERT: (cutting Giselle off) “I think your time would be better spent focusing on being the lead role of my new ballet. Have your fouettées magically improved since yesterday? And how is that section in the second act you were having trouble with? Really, Giselle, I have taken a big risk casting you as the lead. I hoped you would take it seriously.”

GISELLE: “Oh... I am Albert. I’ve been practicing after rehearsal and after class; any spare moment I have.”

ALBERT: “And this ’spare moment’...?”

GISELLE: “Right, I’ll be on my way to the studio. I won’t let you down, Albert.” (apologetic and chastised)

NARRATOR: Giselle quickly walks to the studio, puts on her pointe shoes, and tirelessly rehearses all night.

### B.2.6 ACT 1 - Scene 5

NARRATOR: The day before opening night, worried about Albert’s recent behavior toward her, Giselle arrives early at the studio to practice. As she enters, Giselle runs into Albert who is carrying a bouquet of flowers.

ALBERT: “Oh, Giselle, there you are. Just the dancer I was looking for. I wanted to give you these. Here.”

GISELLE: “What for?” (hesitantly)

ALBERT: “My behavior yesterday was reprehensible. You just caught me at a bad time.”

GISELLE: “It’s alright, Albert. I know how much pressure you must be under. Is there anything I can do to help?”

ALBERT: “No, no, everything’s fine. Just put in a good rehearsal today. Everything is riding on you, and I know you’ll make me proud.”

NARRATOR: Albert rushes off to prepare for the rehearsal and leaves Giselle to practice in the studio. As she readies herself, Henry appears and approaches Giselle, hesitantly.

HENRY: “Giselle, I need to talk to you about Albert. I know you don’t want to hear this, but he isn’t who he seems. I know he’s a really talented director, but I think he’s hiding something.”

GISELLE: “Oh Henry, you worry too much. Albert has everything under control. Thank you for your concern, but I need to get to rehearsal.”

NARRATOR: Giselle leaves before Henry can continue.

NARRATOR: As the stage rehearsal gets underway, Albert proceeds to push his company members to their limits, particularly Giselle.

ALBERT: “Come now Giselle, we’ve been over this a hundred times! You need to turn upstage not downstage before you exit stage left.” “You’re behind the music, do I need to count it out for you like a child?”

GISELLE: “Of course Albert, I’m sorry.” (weary but aiming to please)

ALBERT: “Sorry isn’t good enough. Do it again!”

HENRY: “We’ve been at this for hours, Mr Albertson, I think our Giselle just needs a break.”

ALBERT: “If you don’t want to be here then leave, Henry! I can find another dancer to replace you in a heartbeat. We’re running out of time and no one said this was going to be easy. We need to be perfect, so either get out or do it again!”

GISELLE: “Albert knows what he’s doing, Henry. Let’s just do as he says.” (whispers)

ALBERT: “From the top! And one and two. . . ”

HENRY: “Giselle, look out!!”

NARRATOR: A light suddenly falls onto the stage narrowly missing Giselle. Giselle jumps back, startled, and collapses to the floor. Henry rushes forward to help his friend.

HENRY: “Giselle! Oh no, it must be her heart! Can you hear me Giselle? This is your fault, Albert! I tried to warn you!”

ALBERT: “Out of my way, Henry! Giselle doesn’t need your help. I’m here.”

NARRATOR: Albert pushes Henry away from Giselle just as she regains consciousness. Hurt and offended, Henry storms out of the theatre. Albert leads Giselle to lie down and rest. Outside, Henry stops to speak to Beatrice who seems to be leaving the rehearsal rather quickly.

HENRY: “Beatrice, where are you going? I can’t believe what just happened. Albert could have killed Giselle!”

BEATRICE: “I think you’re exaggerating Henry, she just fainted, but she must be pretty weak. I don’t think she can handle the lead role, do you?”

NARRATOR: Betty quickly rushes in and interrupts Henry and Beatrice’s conversation.

BETTY: “Henry, what happened?! I was told Giselle had an accident!”

HENRY: “She’s fine, Betty, I promise. There was a technical malfunction onstage and it startled Giselle.”

BETTY: “What?! How could you let this happen?”

NARRATOR: Betty pushes Henry aside and runs into the theatre, leaving Henry feeling dejected.

BEATRICE: “Well, that was a bit dramatic, don’t you think? Giselle’s fine but obviously can’t handle the pressure of being the lead.”

HENRY: (distracted) “What? Oh, she’ll be fine, but Albert needs to stop pushing her so hard! I don’t trust him. He’s relying on too many cheap props to bolster this show. It’s getting dangerous.”

BEATRICE: “Henry, do you think if Giselle got hurt Albert would ask me to play the lead role?”

HENRY: “Huh? Maybe, I don’t know.” (distracted)

NARRATOR: Back inside, Giselle tries to rest but awakens suddenly to find her mother standing over her, grasping her hand in a panic.

BETTY: “Giselle, Giselle, what happened?! You need to be stronger than this if you are going to play the lead. What will Albert think?”

GISELLE: “It was an accident, mom, I couldn’t help it. I’m sorry, I know. . . ” (Betty interrupts)

BETTY: “I am relieved. But really, Giselle, if you want to stay in Albert’s good graces we need to fix this. I don’t know where I went wrong, but somehow we will get through this. You’re going to have to put in extra hours so we can get you back into proper form for opening night. You don’t want Albert to take the lead away from you, do you? No, of course you don’t, love. Now pull yourself together and I’ll meet you in the car.”

NARRATOR: Giselle wearily packs up her things and heads to her mother’s vehicle, but outside the theatre she overhears Albert and Henry in a heated discussion.

ALBERT: “I’ll give you one last chance to get out of my way Henry. . . ”

NARRATOR: Later that evening, Henry stops by Giselle’s house to check in on his good friend.

GISELLE: “Hi, Henry. What are you doing here?”

HENRY: “I just wanted to see how you’re doing after the accident today. I’m so glad to see you’re alright, but I am worried about you. You’re working too hard, and I think you need to take it easy.”

GISELLE: “Thanks, but I’m fine, really! Albert needs me right now -!the whole production and his reputation depend on it. I don’t want to let him down. I’ll be fine. Get some rest, Henry. I’ll see you tomorrow.”

NARRATOR: Giselle falls asleep that night feeling the pressure of the impending ballet. She wants to make her mother proud and impress Albert, but Henry's concerns also begin to worry her. Does she really want to be Giselle?

### B.2.7 ACT 1 - Scene 6

NARRATOR: Giselle has a restless sleep the night before her performance. She dreams she is trapped in a dark forest dancing forever with no hope of escape. Startled, Giselle awakens from her nightmare and cannot return to bed. Instead, she decides to take her mother's advice and head in early to the theatre for some extra practice on the stage. On the way, she runs into Beatrice.

BEATRICE: "Giselle. . . ? You're here early."

GISELLE: "Hi, Beatrice. Yes, I just wanted to get some alone time on the stage."

BEATRICE: "Oh. Well, break a leg."

GISELLE: "Thanks."

BEATRICE: "Oh! Giselle - "

GISELLE: "Yes?"

BEATRICE: "Uh, nothing." (pausing to decide)

NARRATOR: Giselle takes center stage and begins going through her dance sequences for the opening of Act II. As she begins to bourrée across the stage she suddenly falls through the broken trap door and hits her head. Beneath the stage, Giselle lies unconscious and alone.

### B.2.8 ACT 2 - Scene 1

NARRATOR: "Giselle awakens, alone, in a dark forest. Suddenly, four shadowy figures approach and gather around her menacingly until Myrtha arrives and disperses them."

GISELLE: "Where am I?"

MYRTHA: "I'm afraid you've had an accident dear, you are here while your body rests and recovers. But don't worry I'll take care of you and help you discover who has done this to you."

GISELLE: "What? You said I had an accident. You mean someone wanted to hurt me intentionally?"

MYRTHA: "Yes, Giselle, things are not always what they seem. You are a victim of jealousy and betrayal. You'll see. "

NARRATOR: "Myrtha initiates a dance with Giselle who hesitantly follows her lead but soon realises she can't stop dancing. Myrtha's power grows stronger and Giselle feels helpless."

### B.2.9 ACT 2 - Scene 2

NARRATOR: Marie, one of the Wilis, approaches Giselle and whisks her away. Giselle finds they have been transported out of the forest back to the dance studio. Through a haze, Giselle can make out the figure of Albert in his office.

(Marie has a gossiping tone as she influences Giselle to believe Albert deceived her.)

MARIE: "You didn't know this, Giselle, but Albert's company is in big trouble financially. Henry tried to warn you."

#### Revelation 1 (financial)

ALBERT: (on the phone) "I can't afford that! I'll have to go with the cheapest option." (desperate) pause "I heard what you said but I just can't do it. Just get them here fast!" "Oh! Henry! I didn't see you. What are you doing here?!"

HENRY: "Uh I..., sorry, I just wanted to ask you, is everything okay? That sounded pretty bad. You know if you need any help I could - "

ALBERT: “Help?! With what? No, mind your own business. What do you know about running a ballet company?! Go practice your pliés!”

MARIE: “You look surprised, Giselle. I’m sorry to have to show you the truth, but it gets worse. Albert has cut corners throughout this production. It’s no coincidence you got hurt on his stage.”

GISELLE: “ Oh, I don’t know about that. I think I fell because I was tired. I tripped, that’s all, I think?”

**Revelation 2 (romantic past)**

MARIE: “Do you know why Albert started his own company?”

GISELLE: “He told me no one respected his ideas at his old job.”

MARIE: “Believe whatever you want but you should know that there’s a rumour that he had an inappropriate relationship with one of his dancers. Probably more than one.”

**Revelation 3 (rushed to Beatrice after Giselle’s accident)**

MARIE: “Open your eyes Giselle, Albert only cares about himself. Right after your injury he rushed to Beatrice to beg her to play the lead. Don’t you think you should have been his main concern?”

MARIE: “Even now, Albert is working on his production. He has left you alone in the hospital.”

GISELLE: “He’s trying to fix the flawed stage design that caused my injury. He seems sorry I was injured and clearly wants to make it right.”

MARIE: “Whatever, I’m bored.”

NARRATOR: Giselle finds herself back in the forest with her head spinning. But before she can gather her thoughts another Wili, Carla, arrives at Giselle’s side.

### B.2.10 ACT2 - Scene 3

(Wili 2 (Carla) has a sad, defeated tone.)

CARLA: “Giselle, Giselle, come with me. I need to show you something.”

GISELLE: “What? Wait, no, not again.”

CARLA: “Beatrice has always hated you, Giselle. She’s out to get you.”

(sets up the flashback)

**Revelation 1 (Henry warned about stage)**

HENRY: “Oh Beatrice, it’s worse than we thought; Albert’s stage is a disaster. Don’t go near it, and please warn Giselle!”

NARRATOR: Giselle recalls the encounter she had with Beatrice the morning of her accident.

BEATRICE: “Oh! Giselle!”

GISELLE: “Yes?”

BEATRICE: “Uh, nothing.”

(echoes, no need to record twice)

**Revelation 2 (light fell)**

CARLA: “You can’t trust your friends, Giselle. Tell me, where was Beatrice when that light fell at rehearsal and almost hit you?”

**Revelation 3 (asking Henry about role)**

CARLA: "Beatrice has always been jealous of you, Giselle. She thought she would play the lead role in Albert's production and was crushed that he chose you." (flash-back)

BEATRICE: "Henry, do you think if Giselle got hurt Albert would ask me to play the lead role?"

HENRY: "Huh? Maybe, I don't know." (distracted)

**Revelation 4 (romance with Beatrice?)**

MARIE: "Giselle did you ever notice how Albert never looks Beatrice in the eyes? She once liked him too, but ever since you came along he pretty much ignores her. She's never gotten over it."

MARIE: "You really were a beautiful dancer, Giselle."

### B.2.11 ACT 2 - Scene 4

NARRATOR: "Giselle feels very confused and is back in the forest trying to make sense of what she has seen and heard. Before she can sort her thoughts out, Myrtha appears."

**Revelation 1 (knew about Albert's past)**

MYRTHA: "Come with me Giselle. I need to show you the truth about your mother, Betty. She has been keeping secrets from you."

GISELLE: "No, not my Mom. She has always been there for me!"

MYRTHA: "She knew about Albert's bad reputation and didn't even warn you! Instead, she encouraged you to be with him. Giselle, she even told him that if he didn't offer you the lead role she would expose his past to everyone."

BETTY: "I know you'll do the right thing, Albert."

**Revelation 2 & 3 (Henry & Albert warned)**

MYRTHA: "Henry tried to warn your mother about Albert but she brushed him off. Even Albert told her he was worried about your health. All she cared about was that you keep going, Giselle. It's what she always dreamed of for herself."

**Revelation 4 (summary of Betty's criticisms)**

MYRTHA: "Your mother only cares about how you make her look, Giselle. She'll never be satisfied no matter what you do."

BETTY: "Don't eat too much, Giselle" "Stand up straight" "Haven't you had enough to drink?" "When are you going to practice?" "Giselle, you're not going to wear that, are you?"

### B.2.12 ACT 2 - Scene 5

NARRATOR: "Back in the forest Giselle is more confused than ever."

MYRTHA: "Now you must decide who is responsible."

(Question pops up with options) On-screen question: "Who do you think is responsible for Giselle's accidents?"

Everyone, Beatrice, Albert, Betty, No-one

MYRTHA: "How can we make them pay?"

(Question to choose revenge or not) On-screen question: "Do you wish to enact revenge?" Yes/No

With revenge:

MYRTHA: “You’ve made the right choice, Giselle. This is the only way they will learn.”

GISELLE: “Yes, thank you for showing me the truth.”

MYRTHA: “Don’t worry, I’ll always take care of you. You’re one of my Wilis now. There’s no going back.”

(Giselle as a Wili)

(Beatrice revenge):

MYRTHA: “You’ve made the right choice, Giselle. This is the only way they will learn.”

GISELLE: “Yes, thank you for showing me the truth.”

MYRTHA: “Because of you, Beatrice will never dance again.”

(no one guilty revenge)

MYRTHA: “Good choice, Giselle. You surprise me!”

GISELLE: “Thank you for showing me the truth. I’m not a naive little girl anymore. Now it’s your turn to pay.”

MYRTHA: “Giselle?”

GISELLE: “You are no longer needed here.”

Forgiveness option:

MYRTHA: “You disappoint me, Giselle. I expected more from you.”

GISELLE: “I’m tired of being told what to do. I will choose what I want.”

MYRTHA: “Let’s show Giselle what we think of her defiance!”

WILI 2 (Carla): “You should have listened to her!”

GISELLE: “She doesn’t really have power over you, you have a choice.”

WILI 1 (Marie): “What do you mean, Giselle?”

GISELLE: “We don’t need Myrtha we can live our own lives.” (Giselle leads the Wilis in freeing dance)

### B.2.13 ENDINGS

**Everyone–Revenge**

Giselle remains a Wili

NARRATOR: “Giselle never wakes up from her coma; she stays trapped as a Wili forever. Myrtha carries out Giselle’s revenge on her friends and family. Beatrice gets the lead role in Albert’s production but suffers a terrible injury on opening night and never dances again. Betty is devastated that her daughter never wakes up and sues Albert’s company for negligence. Albert is ruined, he never works in the dance world again.”

**Everyone–Forgiveness**

Wakes Up–Independant/Alone-leaves

NARRATOR: “Giselle wakes up from her coma with a new-found perspective. She decides to leave Albert’s company and her mother’s house. Giselle sets off on her own and joins a new dance company.”

**Beatrice–Revenge**

Injury–Giselle wakes up and has to live with consequences/guilt

NARRATOR: “Myrtha carries out Giselle’s revenge on Beatrice. Beatrice gets the lead role in Albert’s production but suffers a terrible injury on opening night and never dances again. Giselle must live with the guilt of her decision.”

**Beatrice–Forgiveness**

Giselle gives Beatrice the role of Giselle. Giselle stays with Albert’s company

and promoted to first soloist NARRATOR: “As Giselle recovers, Beatrice plays the lead role in Albert’s production. Giselle returns from her injury and is promoted

to first soloist in Albert's company. Beatrice feels badly for the way she treated Giselle and they work together in the company for many years."

**Albert–Revenge**

Financial/career death. Stays a Wili

NARRATOR: "Myrtha carries out Giselle's revenge on Albert. His company falls into financial ruin and he is unable to fix his tarnished reputation. Giselle never wakes up from her coma; she stays trapped as a Wili forever."

**Albert–Forgiveness**

Giselle wakes up and talks to Albert. Stays with the company but has wisdom.

NARRATOR: "Giselle wakes up from her coma and continues dancing in Albert's company. With her new-found perspective Giselle decides to live on her own for a while so she can re-evaluate her relationships with her friends and family."

**Betty–Revenge**

Giselle stays a Wilis. Betty hearbroken.

NARRATOR: "Betty is devastated that her daughter never wakes up from her coma. Giselle stays trapped as a Wili forever."

**Betty–Forgiveness**

Giselle leaves dance behind her and has a new career that she loves. Helps Betty become dance teacher

NARRATOR: "Giselle wakes up from her coma, and with a new-found perspective decides to leave the dance world to find her true passion in life. She forgives her mother and helps Betty pursue her desire to be a dance teacher."

**No One–Revenge**

Giselle becomes Myrtha

NARRATOR: "Giselle never wakes up from her coma. She usurps Myrtha's position and takes control of the Wilis. Giselle then carries out revenge on her friends and family: Beatrice gets the lead role in Albert's production but suffers a terrible injury on the opening night and never dances again. Betty is devastated that her daughter never wakes up from her coma and sues Albert's company for negligence. Albert is ruined, he never works in the dance world again."

**No One–Forgiveness**

Giselle wakes up, stays with the company with new found wisdom and dedication to her goals.

NARRATOR:"Giselle wakes up from her coma. She continues dancing in Albert's company and is soon promoted to principal dancer."

# Appendix C

# iGiselle story domain description in PDDL

```
(:action arrives_at_studio
:parameters (?p1)
:precondition (and (person ?p1) (protagonist ?p1) (leave_home ?p1) )
:effect (and (at_studio ?p1) (increase (total-cost) 1)) )

(:action warms_up_confidently
:parameters (?p1)
:precondition (and (person ?p1) (at_studio ?p1) (alive ?p1)
(protagonist ?p1) (not (noticed ?p1) ) )
:effect (and (noticed ?p1) (increase (total-cost) 2) ))

(:action warms_up_in_corner
:parameters (?p1)
:precondition (and (person ?p1) (at_studio ?p1) (alive ?p1)
(protagonist ?p1) (not (noticed ?p1) ) )
:effect (and (noticed ?p1) (increase (total-cost) 3) ))

(:action introduce
:parameters (?p1)
:precondition (and (person ?p1) (at_studio ?p1) (alive ?p1)
(protagonist ?p1) (not (noticed ?p1)) )
:effect (and (noticed ?p1) (increase (total-cost) 4) ))

(:action greet
:parameters (?p1 ?p2 ?p3)
:precondition (and (at_studio ?p1)(person ?p2) (person ?p1)(person
?p3) (student ?p3) (knows ?p2 ?p1) (knows ?p1 ?p2) (man ?p2)(woman
?p3) (alive ?p2) (alive ?p1) (alive ?p3) (noticed ?p1) (protagonist
?p1) (not (knows ?p1 ?p3)) (not (knows ?p3 ?p1)) )
:effect (and (knows ?p3 ?p1) (knows ?p1 ?p3)(rival ?p3) (increase
(total-cost) 5) ))

(:action start_dance
:parameters (?p1 ?p2 ?p3 ?p4)
:precondition (and (at_studio ?p1)(person ?p1) (person ?p2) (person
?p3) (person ?p4) (alive ?p1) (alive ?p2) (alive ?p3) (alive ?p4)
(man ?p2) (man ?p4) (protagonist ?p1) (knows ?p3 ?p1) (knows ?p1 ?p3)
(knows ?p2 ?p1) (knows ?p1 ?p2) (rival ?p3) (noticed ?p1)(not(mother
?p3)) (not (knows ?p4 ?p1)) (not (knows ?p1 ?p4)) )
:effect (and (knows ?p4 ?p1)(dance ?p1) (knows ?p1 ?p4) (increase
```

```
(total-cost) 6) ))

(:action stop_dance
:parameters (?p1 ?p2 ?p3 ?p4)
:precondition (and (dance ?p1)(at_studio ?p1)(person ?p1) (person
?p2) (person ?p3) (person ?p4) (alive ?p1) (alive ?p2) (alive
?p3) (alive ?p4) (man ?p2) (man ?p4) (protagonist ?p1) (rival ?p3)
(noticed ?p1) (director ?p4) (not (director ?p2)) )
:effect (and (stop_dance ?p1) (increase (total-cost) 6) ))

(:action compliments
:parameters (?p1 ?p2)
:precondition (and (stop_dance ?p1)(at_studio ?p1)(person ?p1)
(person ?p2) (knows ?p1 ?p2) (knows ?p2 ?p1) (alive ?p1) (alive ?p2)
(director ?p2) (protagonist ?p1))
:effect (and (happy ?p1) (increase (total-cost) 7) ))

(:action greets_rival
:parameters (?p1 ?p2)
:precondition (and (happy ?p1)(person ?p1) (person ?p2) (alive ?p1)
(alive ?p2) (protagonist ?p1) (rival ?p2) (not (emotionBad ?p2)))
:effect (and (emotionBad ?p2) (increase (total-cost) 9)))

(:action meets_teacher
:parameters (?p1 ?p2 ?p4)
:precondition (and (person ?p1) (person ?p2) (person ?p4) (alive ?p4)
(alive ?p1) (alive ?p2) (protagonist ?p1) (teacher ?p4) (emotionBad
?p2) (knows ?p1 ?p2) (knows ?p2 ?p1) (rival ?p2))
:effect (and (contract ?p1) (increase (total-cost) 9)))

(:action dances
:parameters (?p1 ?p2 ?p3 ?p4)
:precondition (and (person ?p1) (person ?p2) (person ?p3) (person
?p4) (alive ?p1) (alive ?p2) (protagonist ?p1) (teacher ?p4) (friend
?p3) (alive ?p3) (alive ?p4) (rival ?p2) (not (impressed ?p4))
(contract ?p1))
:effect (and (impressed ?p4) (increase (total-cost) 9)))

(:action offers_roles
:parameters (?p4 ?p1 ?p2 ?p3)
:precondition (and (person ?p1) (person ?p2) (person ?p3) (person
?p4) (alive ?p1) (alive ?p2) (alive ?p3) (protagonist ?p1) (rival
?p2) (teacher ?p4) (friend ?p3) (alive ?p4) (impressed ?p4) (not
(offeredrole ?p1 ?p4)) (not (offeredrole ?p3 ?p4)))
:effect (and (offeredrole ?p1 ?p4) (offeredrole ?p3 ?p4) (increase
(total-cost) 9)))

(:action accepts_rolesA
:parameters (?p1 ?p2 ?p3 ?p4 ?p5)
:precondition (and (person ?p1) (person ?p2) (person ?p3) (person
?p4) (person ?p5) (alive ?p1) (alive ?p2) (alive ?p3) (protagonist
?p1) (rival ?p2) (teacher ?p4) (friend ?p3) (parent ?p5) (alive ?p4)
(alive ?p5) (offeredrole ?p1 ?p4) (offeredrole ?p3 ?p4) (not (proud
?p5))(not (lead ?p1)) (not (malerole ?p3)) (not (emotion_good ?p1))
(not (understudy ?p2)) (not (insulted ?p2)) (not (replied ?p1)))
:effect (and (lead ?p1) (malerole ?p3) (emotion_good ?p1) (understudy
?p2) (insulted ?p2) (replied ?p1) (proud ?p5) (bold ?p1) (increase
(total-cost) 9)))
```

```
(:action accepts_rolesB
:parameters (?p1 ?p2 ?p3 ?p4 ?p5)
:precondition (and (person ?p1) (person ?p2) (person ?p3) (person
?p4) (person ?p5) (alive ?p1) (alive ?p2) (alive ?p3) (protagonist
?p1) (rival ?p2) (teacher ?p4) (friend ?p3) (parent ?p5) (alive ?p4)
(alive ?p5) (offeredrole ?p1 ?p4) (offeredrole ?p3 ?p4) (not (proud
?p5))(not (lead ?p1)) (not (malerole ?p3)) (not (emotion_good ?p1))
(not (understudy ?p2)) (not (insulted ?p2)) (not (replied ?p1)))
:effect (and (lead ?p1) (malerole ?p3) (emotion_good ?p1) (understudy
?p2) (insulted ?p2) (replied ?p1) (proud ?p5) (shy ?p1) (increase
(total-cost) 9)))

(:action accepts_rolesC
:parameters (?p1 ?p2 ?p3 ?p4 ?p5)
:precondition (and (person ?p1) (person ?p2) (person ?p3) (person
?p4) (person ?p5) (alive ?p1) (alive ?p2) (alive ?p3) (protagonist
?p1) (rival ?p2) (teacher ?p4) (friend ?p3) (parent ?p5) (alive ?p4)
(alive ?p5) (offeredrole ?p1 ?p4) (offeredrole ?p3 ?p4) (not (proud
?p5))(not (lead ?p1)) (not (malerole ?p3)) (not (emotion_good ?p1))
(not (understudy ?p2)) (not (insulted ?p2)) (not (replied ?p1)))
:effect (and (lead ?p1) (malerole ?p3) (emotion_good ?p1) (understudy
?p2) (insulted ?p2) (replied ?p1) (proud ?p5) (friendly ?p1)
(increase (total-cost) 9)))

(:action invites_party
:parameters (?p1 ?p2 ?p3 ?p4 ?p5)
:precondition (and (person ?p1) (person ?p2) (person ?p3) (person
?p4) (person ?p5) (alive ?p1) (alive ?p2) (alive ?p3) (protagonist
?p1) (rival ?p2) (teacher ?p4) (friend ?p3) (parent ?p5) (alive ?p4)
(alive ?p5) (lead ?p1) (malerole ?p3) (emotion_good ?p1) (insulted
?p2) (understudy ?p2) (proud ?p5) (replied ?p1) (not (invited ?p1))
(not (invited ?p2)) (not (invited ?p3)) (not (invited ?p4)))
:effect (and (inviter ?p1) (invited ?p2) (invited ?p3) (invited ?p4)
(increase (total-cost) 9)))

(:action choreographs_dance
:parameters (?p1 ?p2)
:precondition (and (inviter ?p1)(person ?p1) (person ?p2) (female
?p1) (male ?p2) (student ?p1) (teacher ?p2) (knows ?p1 ?p2) (knows
?p2 ?p1))
:effect (and (has_feelings_for ?p1 ?p2) (has_feelings_for ?p2 ?p1)
(prepares_for_party ?p1) (increase (total-cost) 1) ) )

(:action party_begins
:parameters (?p1 ?p2 ?p3 ?p4 ?p5)
:precondition (and (person ?p1) (person ?p2) (person ?p3) (person
?p4) (person ?p5) (host ?p1) (host ?p3) (guest ?p2) (guest
?p4) (guest ?p5) (mother ?p3) (daughter ?p1) (teacher ?p2)
(rivals ?p1 ?p4) (rivals ?p4 ?p1) (friends ?p1 ?p5) (friends
?p5 ?p1) (has_feelings_for ?p1 ?p2) (has_feelings_for ?p2
?p1)(prepares_for_party ?p1))
:effect (and (near ?p4 ?p5) (near ?p5 ?p4) (greets_guests ?p1)
(greets_guests ?p3) (party_begins ?p1) (increase (total-cost) 1))
)

(:action chastise
:parameters (?p1 ?p3)
:precondition (and (person ?p1) (person ?p3) (mother ?p3) (daughter
?p1) (host ?p1) (host ?p3) (party_begins ?p1))
```

```
:effect (and (chastiser ?p3) (chastised ?p1) (emotion stressed)
(increase (total-cost) 1)) )

(:action notice_lurking
:parameters (?p1 ?p4)
:precondition (and (person ?p1) (person ?p4) (rivals ?p1 ?p4) (rivals
?p4 ?p1) (chastised ?p1) (not (resolved ?p1)) (host ?p1) (guest ?p4)
(lurking ?p4))
:effect (and (notices_lurking ?p1) (noticed ?p4) (increase
(total-cost) 1)) )

(:action do_not_confront_lurking
:parameters (?p1 ?p4)
:precondition (and (person ?p1) (person ?p4) (rivals ?p1 ?p4) (rivals
?p4 ?p1) (host ?p1) (guest ?p4) (notices_lurking ?p1) (noticed ?p4)
(not (resolved ?p1)))
:effect (and (resolved ?p1) (increase (total-cost) 2)) )

(:action confront_lurking
:parameters (?p1 ?p4)
:precondition (and (person ?p1) (person ?p4) (rivals ?p1 ?p4) (rivals
?p4 ?p1) (host ?p1) (guest ?p4) (notices_lurking ?p1) (noticed ?p4)
(not (resolved ?p1)))
:effect (and (threatens ?p4 ?p1) (increase (total-cost) 1)) )

(:action dance_off
:parameters (?p1 ?p4)
:precondition (and (person ?p1) (person ?p4) (rivals ?p1 ?p4) (rivals
?p4 ?p1) (host ?p1) (guest ?p4) (notices_lurking ?p1) (noticed ?p4)
(threatens ?p4 ?p1) (not (resolved ?p1)))
:effect (and (loses ?p4) (wins ?p1) (resolved ?p1) (increase
(total-cost) 70000000)) )

(:action apologizes
:parameters (?p1 ?p4)
:precondition (and (person ?p1) (person ?p4) (rivals ?p1 ?p4) (rivals
?p4 ?p1) (host ?p1) (guest ?p4) (notices_lurking ?p1) (noticed ?p4)
(threatens ?p4 ?p1) (not (resolved ?p1)))
:effect (and (apologizes ?p1) (accepts_apology ?p4) (resolved ?p1)
(increase (total-cost) 80)) )

(:action cries
:parameters (?p1 ?p3 ?p4)
:precondition (and (person ?p1) (person ?p3) (person ?p4) (daughter
?p1) (mother ?p3) (threatens ?p4 ?p1) (rivals ?p1 ?p4) (rivals ?p4
?p1) (host ?p1) (guest ?p4) (not (resolved ?p1)) (notices_lurking
?p1))
:effect (and (conforts ?p3 ?p1) (resolved ?p1) (increase (total-cost)
60015)) )

(:action propose
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (has_feelings_for
?p1 ?p2) (has_feelings_for ?p2 ?p1) (host ?p1) (guest ?p2)
(notices_lurking ?p1) (resolved ?p1))
:effect (and (proposes_to ?p2 ?p1) (increase (total-cost) 1)) )

(:action respond_maybe
:parameters (?p1 ?p2)
```

```
:precondition (and (person ?p1) (person ?p2) (has_feelings_for ?p1
?p2) (has_feelings_for ?p1 ?p2) (host ?p1) (guest ?p2) (proposes_to
?p2 ?p1))
:effect (and (considers_proposal ?p1) (increase (total-cost)
80000000)) )

(:action respond_hestitant_yes
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (has_feelings_for ?p1
?p2) (has_feelings_for ?p1 ?p2) (host ?p1) (guest ?p2) (proposes_to
?p2 ?p1))
:effect (and (hesitantly_accepts_proposal ?p1) (increase (total-cost)
20040060)) )

(:action respond_yes
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (has_feelings_for ?p1
?p2) (has_feelings_for ?p1 ?p2) (host ?p1) (guest ?p2) (proposes_to
?p2 ?p1))
:effect (and (accepts_proposal ?p1) (increase (total-cost) 80030)) )

(:action confides_maybe
:parameters (?p1 ?p3)
:precondition (and (person ?p1) (person ?p3) (daughter ?p1) (mother
?p3) (considers_proposal ?p1) (chastiser ?p3))
:effect (and (encourages ?p3 ?p1) (is_reassured ?p1) (increase
(total-cost) 1)) )

(:action confides_hesitant_yes
:parameters (?p1 ?p3)
:precondition (and (person ?p1) (person ?p3) (daughter ?p1) (mother
?p3) (hesitantly_accepts_proposal ?p1) (chastiser ?p3))
:effect (and (encourages ?p3 ?p1) (is_reassured ?p1) (increase
(total-cost) 1)) )

(:action confides_yes
:parameters (?p1 ?p3)
:precondition (and (person ?p1) (person ?p3) (chastiser ?p3)
(daughter ?p1) (mother ?p3) (accepts_proposal ?p1))
:effect (and (encourages ?p3 ?p1) (is_reassured ?p1) (increase
(total-cost) 1)) )

(:action clean_up_party
:parameters (?p1 ?p3)
:precondition (and (person ?p1) (person ?p3) (daughter ?p1) (mother
?p3) (encourages ?p3 ?p1) (is_reassured ?p1))
:effect (and (cleans_up_party ?p3) (goes_to_bed ?p1) (increase
(total-cost) 1)) )

(:action storms_out
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (student ?p1) (student
?p2) (female ?p1) (male ?p2) (goes_to_bed ?p1) )
:effect (and (storms_out ?p2) (stops ?p1 ?p2) (increase (total-cost)
1)) )

(:action comforts
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (student ?p1)
```

```
(not (suspicious ?p1)) (student ?p2) (female ?p1) (male ?p2)
(has_feelings_for ?p2 ?p1) (not (has_feelings_for ?p1 ?p2))
(storms_out ?p2) (stops ?p1 ?p2))
:effect (and (tries_to_confort ?p1 ?p2) (in_dance_studio
?p1)(increase (total-cost) 1)) )

(:action slams_door
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (student ?p1)
(student ?p2) (female ?p1) (male ?p2) (has_feelings_for ?p2
?p1) (not (has_feelings_for ?p1 ?p2)) (tries_to_confort ?p1 ?p2)
(in_dance_studio ?p1) (in_dance_studio ?p2) (not (alone ?p1)))
:effect (and (slams_door ?p2) (not (in_dance_studio ?p2)) (alone ?p1)
(increase (total-cost) 1)) )

(:action looks_for
:parameters (?p1 ?p3)
:precondition (and (person ?p1) (student ?p1) (female ?p1)
(in_dance_studio ?p1) (alone ?p1) (person ?p3) (teacher ?p3)
(male ?p3) (in_dance_studio ?p3) (has_feelings_for ?p3 ?p1)
(has_feelings_for ?p1 ?p3))
:effect (and (looks_for ?p1 ?p3) (increase (total-cost) 1)) )

(:action finds
:parameters (?p1 ?p3)
:precondition (and (person ?p1) (student ?p1) (female ?p1)
(in_dance_studio ?p1) (alone ?p1) (person ?p3) (teacher ?p3)
(male ?p3) (in_dance_studio ?p3) (has_feelings_for ?p3 ?p1)
(has_feelings_for ?p1 ?p3) (looks_for ?p1 ?p3))
:effect (and (finds ?p1 ?p3) (not (alone ?p1)) (increase (total-cost)
1)) )

(:action questions
:parameters (?p1 ?p3)
:precondition (and (person ?p1) (student ?p1) (female ?p1)
(in_dance_studio ?p1) (person ?p3) (teacher ?p3) (male ?p3)
(in_dance_studio ?p3) (has_feelings_for ?p3 ?p1) (has_feelings_for
?p1 ?p3) (finds ?p1 ?p3) (not (alone ?p1)))
:effect (and (asks_question ?p1) (increase (total-cost) 1)) )

(:action insists_upon_more_practicing
:parameters (?p3 ?p1)
:precondition (and (person ?p1) (student ?p1) (female ?p1)
(in_dance_studio ?p1) (person ?p3) (teacher ?p3) (male ?p3)
(in_dance_studio ?p3) (has_feelings_for ?p3 ?p1) (has_feelings_for
?p1 ?p3) (not (alone ?p1)) (asks_question ?p1))
:effect (and (insists_upon_more_practicing ?p3) (walks_away ?p1)
(increase (total-cost) 1)) )

(:action practices_all_night
:parameters (?p1)
:precondition (and (person ?p1) (student ?p1) (female ?p1)
(in_dance_studio ?p1) (walks_away ?p1) )
:effect (and (practices_all_night ?p1) (home ?p1) (increase
(total-cost) 1)) )

(:action worries_about_behaviour
:parameters (?p1)
:precondition (and (person ?p1) (not (in_forest ?p1)) (not
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(flashback ?p1)) (student ?p1) (practices_all_night ?p1) (female
?p1) (protagonist ?p1) (home ?p1))
:effect (and (worried ?p1) (not (home ?p1)) (in_dance_studio ?p1)
(increase (total-cost) 5)))

(:action offers_flowers
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (student ?p1) (not
(flashback ?p1)) (not (in_forest ?p1)) (female ?p1) (protagonist
?p1) (teacher ?p2) (male ?p2) (worried ?p1) (not (home ?p1))
(in_dance_studio ?p1))
:effect (and (offers_flowers ?p2 ?p1) (not (worried ?p1)) (increase
(total-cost) 5)))

(:action accepts_flowers
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (not (flashback ?p1))
(student ?p1) (female ?p1) (protagonist ?p1) (teacher ?p2) (male ?p2)
(not (home ?p1)) (in_dance_studio ?p1) (offers_flowers ?p2 ?p1) (not
(worried ?p1)))
:effect (and (accepts_offer ?p1) (increase (total-cost) 5)))

(:action leaves
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (student ?p1) (female
?p1) (not (solitary ?p1)) (protagonist ?p1) (teacher ?p2) (male
?p2) (not (home ?p1)) (in_dance_studio ?p1) (not (worried ?p1))
(accepts_offer ?p1))
:effect (and (leaves ?p2) (solitary ?p1) (increase (total-cost) 5)) )

(:action approaches
:parameters (?p1 ?p3)
:precondition (and (person ?p1) (person ?p3) (not (flashback ?p1))
(student ?p1) (student ?p3) (female ?p1) (male ?p3) (protagonist ?p1)
(solitary ?p1))
:effect (and (approaches ?p3 ?p1) (disagrees_with ?p1 ?p3)
(disagrees_with ?p3 ?p1) (leaves ?p1) (increase (total-cost) 5)))

(:action rehersal_begins
:parameters (?p1 ?p2 ?p3)
:precondition (and (person ?p1) (person ?p2) (person ?p3) (leaves
?p1) (female ?p1) (male ?p2) (male ?p3) (student ?p1) (student
?p3) (teacher ?p2) (protagonist ?p1) (disagrees_with ?p1 ?p3)
(disagrees_with ?p3 ?p1))
:effect (and (rehersal_begins ?p1) (increase (total-cost) 5)))

(:action light_suddenly_falls
:parameters (?p1 ?p2 ?p3)
:precondition (and (person ?p1) (person ?p2) (person ?p3) (female
?p1) (male ?p2) (male ?p3) (student ?p1) (student ?p3) (teacher ?p2)
(protagonist ?p1) (rehersal_begins ?p1))
:effect (and (collapses ?p1) (increase (total-cost) 5)))

(:action tries_to_help
:parameters (?p1 ?p2 ?p3)
:precondition (and (person ?p1) (person ?p2) (person ?p3) (female
?p1) (male ?p2) (male ?p3) (student ?p1) (student ?p3) (teacher ?p2)
(protagonist ?p1) (collapses ?p1))
:effect (and (tries_to_help ?p3) (increase (total-cost) 5)) )
```

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(:action yells
:parameters (?p1 ?p2 ?p3)
:precondition (and (person ?p1) (person ?p2) (person ?p3) (female
?p1) (male ?p2) (male ?p3) (student ?p1) (student ?p3) (teacher ?p2)
(protagonist ?p1) (collapses ?p1) (tries_to_help ?p3))
:effect (and (leaves ?p3) (increase (total-cost) 5)) )

(:action converses
:parameters (?p3 ?p5)
:precondition (and (person ?p3) (person ?p5) (student ?p3) (student
?p5) (male ?p3) (female ?p5) (not (protagonist ?p5)) (leaves ?p3))
:effect (and (speaks_with ?p3 ?p5) (increase (total-cost) 5)))

(:action interrupts
:parameters (?p3 ?p5 ?p6)
:precondition (and (person ?p3) (person ?p5) (person ?p6) (student
?p3) (student ?p5) (mother ?p6) (male ?p3) (female ?p5) (not
(protagonist ?p5)) (speaks_with ?p3 ?p5))
:effect (and (interrupts ?p6) (increase (total-cost) 5)))

(:action blames
:parameters (?p3 ?p5 ?p6)
:precondition (and (person ?p3) (person ?p5) (person ?p6) (interrupts
?p6) (student ?p3) (student ?p5) (mother ?p6) (male ?p3) (female ?p5)
(not (protagonist ?p5)) )
:effect (and (blames ?p6 ?p3) (in_dance_studio ?p6) (frustrated ?p3)
(increase (total-cost) 5)) )

(:action conversation_continues
:parameters (?p3 ?p5)
:precondition (and (person ?p3) (person ?p5) (student ?p3) (student
?p5) (male ?p3) (female ?p5) (not (protagonist ?p5)) (frustrated
?p3))
:effect (and (distracted ?p3) (increase (total-cost) 5)))

(:action lectures
:parameters (?p1 ?p6 ?p3)
:precondition (and (person ?p1) (person ?p6) (person ?p3) (daughter
?p1) (student ?p1) (mother ?p6) (female ?p6) (female ?p1) (male ?p3)
(student ?p3) (distracted ?p3))
:effect (and (lectures ?p6 ?p1) (confused ?p1) (increase (total-cost)
5)))

(:action overhears_yelling
:parameters (?p1 ?p2 ?p3)
:precondition (and (person ?p1) (person ?p2) (person ?p3) (female
?p1) (male ?p2) (male ?p3) (student ?p1) (student ?p3) (teacher ?p2)
(protagonist ?p1) (confused ?p1))
:effect (and (overhears2 ?p1 ?p2) (not (satisfied ?p1)) (increase
(total-cost) 5)))

(:action interrupts_conversation
:parameters (?p1 ?p2 ?p3)
:precondition (and (person ?p1) (not (suspicious ?p1)) (not
(in_forest ?p1)) (person ?p2) (not (satisfied ?p1)) (person ?p3)
(female ?p1) (male ?p2) (male ?p3) (student ?p1) (student ?p3)
(teacher ?p2) (protagonist ?p1) (overhears2 ?p1 ?p2))
:effect (and (interrupts ?p1) (not (in_dance_studio ?p1)) (home ?p1)
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(resting ?p1) (increase (total-cost) 40000000)) )

(:action eavesdrops
:parameters (?p1 ?p2 ?p3)
:precondition (and (person ?p1) (person ?p2) (not (satisfied ?p1))
(person ?p3) (female ?p1) (male ?p2) (male ?p3) (student ?p1)
(student ?p3) (teacher ?p2) (protagonist ?p1) (overhears ?p1 ?p2))
:effect (and (eavesdrops ?p1) (not (in_dance_studio ?p1)) (home ?p1)
(resting ?p1) (increase (total-cost) 40000)) )

(:action leaves2
:parameters (?p1 ?p2 ?p3)
:precondition (and (person ?p1) (person ?p2) (not (satisfied ?p1))
(person ?p3) (female ?p1) (male ?p2) (male ?p3) (student ?p1)
(student ?p3) (teacher ?p2) (protagonist ?p1) (overhears ?p1 ?p2))
:effect (and (does_nothing ?p1) (not (in_dance_studio ?p1)) (home
?p1) (resting ?p1) (increase (total-cost) 40)) )

(:action visit
:parameters (?p1 ?p3)
:precondition (and (person ?p1) (person ?p3) (student ?p1) (student
?p3) (male ?p3) (female ?p1) (protagonist ?p1) (not (in_dance_studio
?p1)) (home ?p1) (resting ?p1))
:effect (and (visits ?p3 ?p1) (stressed ?p1) (tired ?p1) (increase
(total-cost) 5)) )

(:action goes_to_bed
:parameters (?p1)
:precondition (and (person ?p1) (not (in_forest ?p1)) (female ?p1)
(stressed ?p1) (student ?p1) (protagonist ?p1) (not (in_dance_studio
?p1)) (home ?p1) (tired ?p1))
:effect (and (goes_to_sleep ?p1) (asleep ?p1) (increase (total-cost)
5)) )

(:action has_nightmare
:parameters (?p1 ?p2)
:precondition (and (goes_to_sleep ?p1)(alive ?p1) (person ?p1)
(asleep ?p1) (not (scared ?p1)) (protagonist ?p1) (rival ?p2) (alive
?p2) (person ?p2) (not (meet ?p2 ?p1)))
:effect (and (meet ?p2 ?p1) (not (asleep ?p1)) (increase (total-cost)
9)))

(:action talk_to_rival
:parameters (?p1 ?p2)
:precondition (and (alive ?p1) (person ?p1) (not (worried ?p1))
(alive ?p2) (rival ?p2) (person ?p2) (not (asleep ?p1)) (protagonist
?p1) (rival ?p2) (meet ?p2 ?p1))
:effect (and (wishes_luck ?p1 ?p2) (keeps_secret ?p1 ?p2) (suspicious
?p1) (increase (total-cost) 9)))

(:action practices
:parameters (?p1 ?p2)
:precondition (and (not (faller ?p1)) (not (unconscious ?p1)) (not
(worried ?p1)) (suspicious ?p1) (alive ?p1) (person ?p1) (not (asleep
?p1)) (wishes_luck ?p1 ?p2) (keeps_secret ?p1 ?p2) (protagonist ?p1)
(rival ?p2))
:effect (and (faller ?p1) (unconscious ?p1) (asleep ?p1) (increase
(total-cost) 9)))
   (:action wakes_in_dark_forest
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:parameters (?p1 ?p2 ?p3 ?p4 ?p5 ?p6)
:precondition (and (unconscious ?p1) (faller ?p1) (protagonist
?p1) (person ?p1) (female ?p1) (asleep ?p1) (shadowy_figure ?p3)
(shadowy_figure ?p4) (shadowy_figure ?p5) (shadowy_figure ?p6)(person
?p2) (dream ?p2) (not (arrives ?p2)))
:effect (and (not (asleep ?p1)) (in_forest ?p1) (arrives ?p2)
(increase (total-cost) 1)) )

(:action becomes_confused
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (protagonist ?p1)
(female ?p1) (not (asleep ?p1)) (dream ?p2) (arrives ?p2))
:effect (and (questioning ?p1) (not (arrives ?p2)) (increase
(total-cost) 1)) )

(:action explains_accident
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (protagonist ?p1)
(female ?p1) (not (asleep ?p1)) (dream ?p2) (questioning ?p1))
:effect (and (explains_accident ?p2) (offers_help ?p2) (not
(questioning ?p1)) (increase (total-cost) 1)) )

(:action initiates_dance
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (protagonist ?p1)
(female ?p1) (not (asleep ?p1)) (dream ?p2) (explains_accident ?p2)
(offers_help ?p2) (not (questioning ?p1)))
:effect (and (grows_stronger ?p2) (feels_helpless ?p1) (increase
(total-cost) 1)) )

(:action comes_closer
:parameters (?p1 ?p2)
:precondition (and (wili ?p2) (gossipy ?p2) (protagonist ?p1)
(feels_helpless ?p1) (person ?p1) (female ?p1) (not (invisible ?p1))
(not (invisible ?p2)) )
:effect (and (not (in_forest ?p1)) (not (in_forest ?p2))
(in_dance_studio ?p1) (in_dance_studio ?p2) (invisible ?p1)
(invisible ?p2) (increase (total-cost) 1)) )

(:action gossips
:parameters (?p1 ?p2)
:precondition (and (wili ?p2) (gossipy ?p2) (protagonist ?p1) (person
?p1) (female ?p1) (not (in_forest ?p1)) (invisible ?p1) (invisible
?p2) (not (in_forest ?p2)) (in_dance_studio ?p1) (in_dance_studio
?p2))
:effect (and (gossips ?p2) (flashback ?p1) (increase (total-cost) 1))
)

(:action flashback_on_the_phone
:parameters (?p1 ?p2 ?p3 ?p4)
:precondition (and (person ?p4) (male ?p4) (student ?p4) (wili ?p2)
(gossipy ?p2) (flashback ?p1) (protagonist ?p1) (person ?p1) (female
?p1) (gossips ?p2) (person ?p3) (male ?p3) (teacher ?p3) (invisible
?p1) (invisible ?p2))
:effect (and (notices ?p3 ?p4) (noticed ?p4) (increase (total-cost)
1)) )

(:action offers_help
:parameters (?p1 ?p2 ?p3 ?p4)
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:precondition (and (person ?p3) (person ?p4) (protagonist ?p1)
(flashback ?p1) (male ?p3) (male ?p4) (teacher ?p3) (student ?p4)
(invisible ?p1) (invisible ?p2)(wili ?p2) (person ?p1) (female
?p1)(notices ?p3 ?p4) (noticed ?p4))
:effect (and (offers_help ?p4) (increase (total-cost) 1)) )

(:action rejects_help
:parameters (?p1 ?p2 ?p3 ?p4)
:precondition (and (person ?p3) (person ?p4) (protagonist ?p1)
(flashback ?p1) (male ?p3) (male ?p4) (teacher ?p3) (student ?p4)
(invisible ?p1) (invisible ?p2)(wili ?p2) (gossipy ?p2) (person ?p1)
(female ?p1)(offers_help ?p4))
:effect (and (rejects_offer ?p3) (not (invisible ?p1)) (in_forest
?p1) (not (invisible ?p2)) (increase (total-cost) 1)) )

(:action explains_cutting_corners
:parameters (?p1 ?p2)
:precondition (and (not (invisible ?p1)) (not (invisible
?p2)) (in_forest ?p1) (protagonist ?p1) (in_dance_studio ?p1)
(in_dance_studio ?p2) (wili ?p2) (gossipy ?p2) (person ?p1) (female
?p1))
:effect (and (learns_about_financial_issues ?p1) (increase
(total-cost) 1)) )

(:action explains_romantic_past
:parameters (?p1 ?p2)
:precondition (and (not (invisible ?p1)) (not (invisible ?p2))
(protagonist ?p1) (in_dance_studio ?p1) (in_dance_studio
?p2) (wili ?p2) (gossipy ?p2) (person ?p1) (female ?p1)
(learns_about_financial_issues ?p1))
:effect (and (learns_about_romantic_past ?p1) (increase (total-cost)
1)) )

(:action explains_turning_to_other_dancer
:parameters (?p1 ?p2)
:precondition (and (not (invisible ?p1)) (not (invisible ?p2))
(protagonist ?p1) (in_dance_studio ?p1) (in_dance_studio
?p2) (wili ?p2) (gossipy ?p2) (person ?p1) (female ?p1)
(learns_about_romantic_past ?p1))
:effect (and (learns_about_albert_turning_to_beatrice ?p1) (increase
(total-cost) 1)) )

(:action explains_alone_in_the_hospital
:parameters (?p1 ?p2)
:precondition (and (not (invisible ?p1)) (not (invisible ?p2))
(protagonist ?p1) (in_dance_studio ?p1) (in_dance_studio
?p2) (wili ?p2) (gossipy ?p2) (person ?p1) (female ?p1)
(learns_about_albert_turning_to_beatrice ?p1))
:effect (and (learns_about_being_alone_in_hospital ?p1) (increase
(total-cost) 1)) )

(:action becomes_bored
:parameters (?p1 ?p2)
:precondition (and (not (invisible ?p1)) (not (invisible ?p2))
(not (flashback_ends ?p1)) (protagonist ?p1) (in_dance_studio ?p1)
(in_dance_studio ?p2) (wili ?p2) (gossipy ?p2) (person ?p1) (female
?p1) (learns_about_being_alone_in_hospital ?p1) (not (bored ?p2)))
:effect (and (bored ?p2) (flashback_ends ?p1) (increase (total-cost)
1)) )
```

```
(:action transported_from_dance_studio_to_forest
:parameters (?p1 ?p2 ?p5)
:precondition (and (not (invisible ?p1)) (wili ?p2) (gossipy ?p2)
(bored ?p2) (person ?p1) (female ?p1) (protagonist ?p1) (in_forest
?p1) (in_dance_studio ?p1) (flashback_ends ?p1) (wili ?p5) (sad ?p5))
:effect (and (not (in_dance_studio ?p1)) (in_forest ?p1) (near ?p1
?p5) (near ?p5 ?p1) (arrives ?p5) (increase (total-cost) 1)) )

(:action show
:parameters (?p1 ?p2)
:precondition (and (arrives ?p2) (person ?p1) (protagonist ?p1) (wili
?p2) (sad ?p2))
:effect (and (watching ?p1) (increase (total-cost) 1)) )

(:action showed_revelation_one
:parameters (?p1 ?p2 ?p3)
:precondition (and (person ?p1) (not (director ?p1)) (man ?p1)(rival
?p2) (person ?p2) (person ?p3) (protagonist ?p3) (watching ?p3)
(alive ?p1)(alive ?p2) )
:effect (and (does_nothing ?p2) (increase (total-cost) 2) ))

(:action showed_revelation_two
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (watching ?p1) (person ?p2)
(does_nothing ?p2) (rival ?p2)(protagonist ?p1))
:effect (and (shocked ?p1) (increase (total-cost) 3) ))

(:action showed_revelation_three
:parameters (?p1 ?p2 ?p3)
:precondition (and (person ?p1) (person ?p2) (person ?p3)
(protagonist ?p1) (man ?p2) (not (director ?p2)) (rival ?p3)
(does_nothing ?p3) (shocked ?p1))
:effect (and (not(shocked ?p1)) (suprised ?p1) (increase (total-cost)
4) ))

(:action showed_revelation_four
:parameters (?p1 ?p2 ?p3)
:precondition (and (person ?p1) (suprised ?p1) (person ?p2) (person
?p3) (man ?p2) (rival ?p3) (alive ?p2) (alive ?p1) (alive ?p3)
(protagonist ?p1))
:effect (and (puzzled ?p1) (increase (total-cost) 5) ))

(:action showed_betty_revelation_one
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (protagonist ?p1)
(vindictive ?p2) (puzzled ?p1))
:effect (and (warnning ?p2) (increase (total-cost) 1)) )

(:action showed_betty_revelation_two
:parameters (?p1 ?p2 ?p3)
:precondition (and (person ?p1) (protagonist ?p1) (person ?p2)
(vindictive ?p2) (warnning ?p2) (person ?p3) (mother ?p3))
:effect (and (doesnt_care ?p3) (increase (total-cost) 2) ))

(:action showed_betty_revelation_three
:parameters (?p1 ?p2 ?p3)
:precondition (and (person ?p1) (protagonist ?p1) (person ?p2)
(vindictive ?p2) (mother ?p3) (doesnt_care ?p3))
```

```
:effect (and (warned ?p1) (increase (total-cost) 3) ))

(:action revenge_choice_beatrice
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (protagonist ?p1)
(vindictive ?p2) (not (vengeful ?p1)) (warned ?p1))
:effect (and (vengeful ?p1) (beatrice_revenger ?p1) (increase
(total-cost) 1)) )


(:action forgiveness
:parameters (?p1 ?p2)
:precondition (and (person ?p1) (person ?p2) (protagonist ?p1)
(vindictive ?p2) (vengeful ?p1) (warned ?p1) (not (forgive ?p1))
(not (revenger ?p1)) (not (content ?p1)))
:effect (and (forgiver ?p1)(content ?p1) (decided ?p1) (increase
(total-cost) 1)) )

(:action everyone_revenge
:parameters (?p1 ?p2 ?p4 ?p5 ?p6)
:precondition (and (everyone_revenger ?p1) (not (forgiver
?p1))(person ?p1) (person ?p2) (person ?p4) (person ?p5) (person
?p6) (alive ?p1) (alive ?p2) (alive ?p4) (alive ?p5) (alive ?p6)
(protagonist ?p1) (vindictive ?p6) (director ?p4) (mother ?p5) (rival
?p2) (decided ?p1))
:effect (and (lead ?p2) (injured ?p2) (sues ?p4 ?p5) (sad ?p5) (broke
?p4) (fulfilled ?p1) (increase (total-cost) 9)))

(:action everyone_forgiveness
:parameters (?p1 ?p2 ?p4 ?p5 ?p6)
:precondition (and (forgiver ?p1) (everyone_revenger ?p1) (person
?p1) (person ?p2) (person ?p4) (person ?p5) (person ?p6) (alive ?p1)
(alive ?p2) (alive ?p4)(alive ?p5) (alive ?p6) (protagonist ?p1)
(vindictive ?p6) (director ?p4) (mother ?p5) (rival ?p2) (decided
?p1))
:effect (and (not (coma ?p1)) (leaves2 ?p5 ?p1) (leaves2 ?p4 ?p1)
(wisdom ?p1) (fulfilled ?p1) (increase (total-cost) 9)))

(:action beatrice_revenge
:parameters (?p1 ?p2 ?p4 ?p5 ?p6)
:precondition (and (beatrice_revenger ?p1)(not (forgiver ?p1))(person
?p1) (person ?p2) (person ?p4) (person ?p5) (person ?p6) (alive ?p1)
(alive ?p2) (alive ?p4)(alive ?p5) (alive ?p6) (protagonist ?p1)
(vindictive ?p6) (director ?p4) (mother ?p5) (rival ?p2) (decided
?p1))
:effect (and (not (coma ?p1)) (lead ?p2) (injured ?p2) (guilt ?p1)
(fulfilled ?p1) (increase (total-cost) 9)))

(:action beatrice_forgiveness
:parameters (?p1 ?p2 ?p4 ?p5 ?p6)
:precondition (and (beatrice_revenger ?p1) (forgiver ?p1) (person
?p1) (person ?p2) (person ?p4) (person ?p5) (person ?p6) (alive ?p1)
(alive ?p2) (alive ?p4)(alive ?p5) (alive ?p6) (protagonist ?p1)
(vindictive ?p6) (director ?p4) (mother ?p5) (rival ?p2) (decided
?p1))
:effect (and (not (coma ?p1)) (lead ?p2) (promoted ?p1) (fulfilled
?p1) (increase (total-cost) 9)))

(:action albert_revenge
```

```
:parameters (?p1 ?p2 ?p4 ?p5 ?p6)
:precondition (and (albert_revenger ?p1) (not (forgiver ?p1)) (person
?p1) (person ?p2) (person ?p4) (person ?p5) (person ?p6) (alive ?p1)
(alive ?p2) (alive ?p4)(alive ?p5) (alive ?p6) (protagonist ?p1)
(vindictive ?p6) (director ?p4) (mother ?p5) (rival ?p2) (decided
?p1))
:effect (and (broke ?p4) (sad ?p5) (fulfilled ?p1) (increase
(total-cost) 9)))

(:action albert_forgiveness
:parameters (?p1 ?p2 ?p4 ?p5 ?p6)
:precondition (and (albert_revenger ?p1) (forgiver ?p1) (person ?p1)
(person ?p2) (person ?p4) (person ?p5) (person ?p6) (alive ?p1)
(alive ?p2) (alive ?p4) (alive ?p5) (alive ?p6) (protagonist ?p1)
(vindictive ?p6) (director ?p4) (mother ?p5) (rival ?p2) (decided
?p1))
:effect (and (not (coma ?p1)) (leaves2 ?p5 ?p1) (wisdom ?p1)
(fulfilled ?p1) (increase (total-cost) 9)))

(:action betty_revenge
:parameters (?p1 ?p2 ?p4 ?p5 ?p6)
:precondition (and (betty_revenger ?p1) (not (forgiver ?p1)) (person
?p1) (person ?p2) (person ?p4) (person ?p5) (person ?p6) (alive ?p1)
(alive ?p2) (alive ?p4)(alive ?p5) (alive ?p6) (protagonist ?p1)
(vindictive ?p6) (director ?p4) (mother ?p5) (rival ?p2) (decided
?p1))
:effect (and (sad ?p5) (lead ?p2) (injured ?p2) (guilt ?p1)
(fulfilled ?p1) (increase (total-cost) 9)))

(:action betty_forgiveness
:parameters (?p1 ?p2 ?p4 ?p5 ?p6)
:precondition (and (betty_revenger ?p1) (forgiver ?p1) (person ?p1)
(person ?p2) (person ?p4) (person ?p5) (person ?p6) (alive ?p1)
(alive ?p2) (alive ?p4)(alive ?p5) (alive ?p6) (protagonist ?p1)
(vindictive ?p6) (director ?p4) (mother ?p5) (rival ?p2) (decided
?p1))
:effect (and (not (coma ?p1)) (leaves_dance ?p1) (forgives ?p5 ?p1)
(helps ?p5 ?p1) (fulfilled ?p1) (increase (total-cost) 9)))

(:action no_one_revenge
:parameters (?p1 ?p2 ?p4 ?p5 ?p6)
:precondition (and (no_one_revenger ?p1) (not (forgiver ?p1)) (person
?p1) (person ?p2) (person ?p4) (person ?p5) (person ?p6) (alive ?p1)
(alive ?p2) (alive ?p4)(alive ?p5) (alive ?p6) (protagonist ?p1)
(vindictive ?p6) (director ?p4) (mother ?p5) (rival ?p2) (decided
?p1))
:effect (and (lead ?p2) (injury ?p2) (sues ?p4 ?p5) (sad ?p5) (broke
?p4) (fulfilled ?p1) (increase (total-cost) 9)))

(:action no_one_forgiveness
:parameters (?p1 ?p2 ?p4 ?p5 ?p6)
:precondition (and (no_one_revenger ?p1) (forgiver ?p1) (person ?p1)
(person ?p2) (person ?p4) (person ?p5) (person ?p6) (alive ?p1)
(alive ?p2) (alive ?p4)(alive ?p5) (alive ?p6) (protagonist ?p1)
(vindictive ?p6) (director ?p4) (mother ?p5) (rival ?p2) (decided
?p1))
:effect (and (not (coma ?p1)) (wisdom ?p1) (lead ?p1) (fulfilled ?p1)
(increase (total-cost) 9)))
```

```
(:action the_end
:parameters (?p1 ?p2 ?p4 ?p5 ?p6)
:precondition (and (person ?p1) (person ?p2) (person ?p4) (person
?p5) (person ?p6) (alive ?p1) (alive ?p2) (alive ?p4) (alive ?p5)
(alive ?p6) (protagonist ?p1) (vindictive ?p6) (director ?p4) (mother
?p5) (rival ?p2) (decided ?p1) (fulfilled ?p1))
:effect (and (the_end ?p1) (increase (total-cost) 9)))
```

# Appendix D

# iGiselle screenshots

Figure D.1: Screens from Act 1 Scene 1.

Figure D.2: Screens from Act 1 Scene 1 and Scene 2.

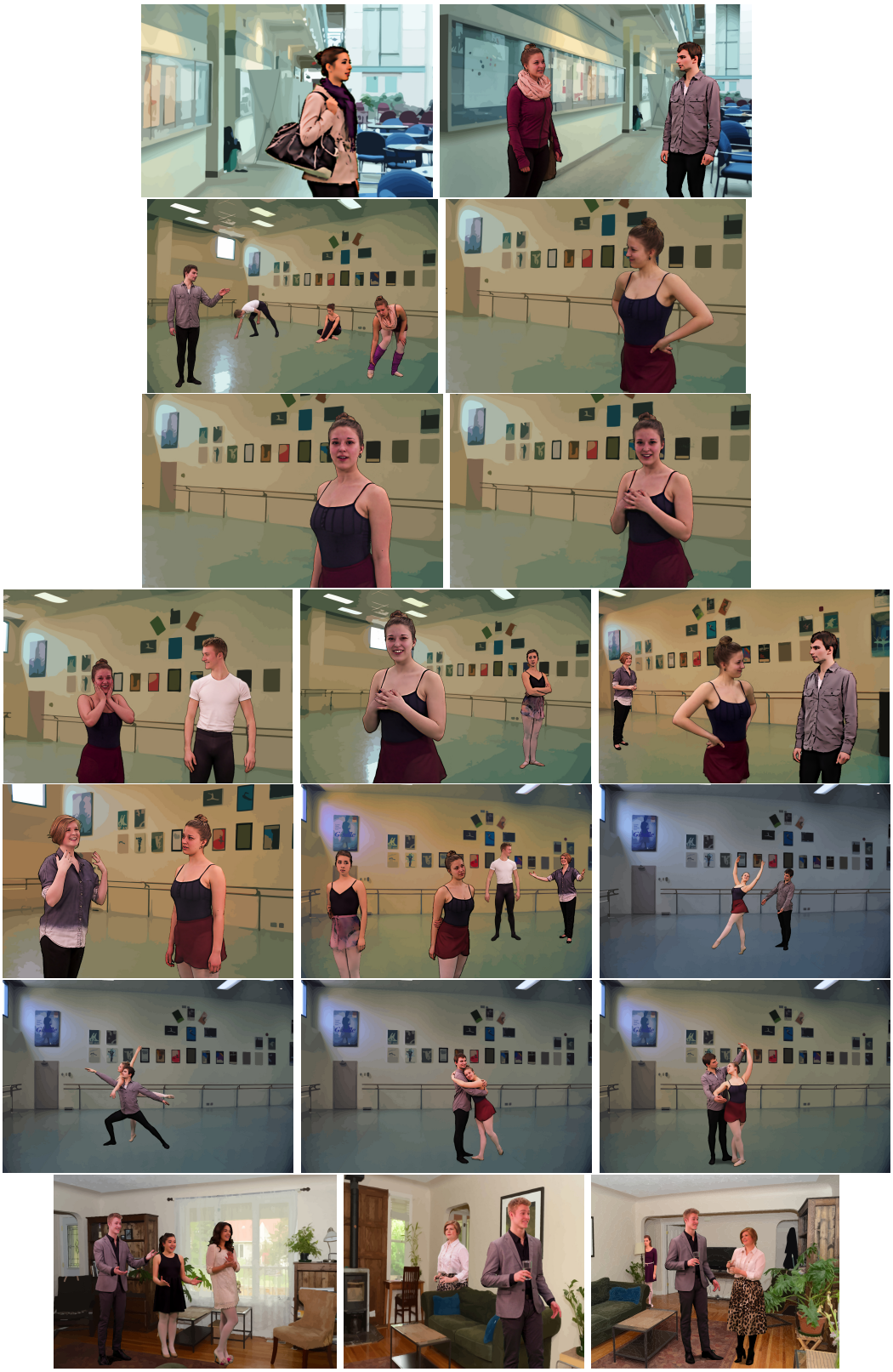


Figure D.3: Screens from Act 1 Scene 2 and Scene 3.

Figure D.4: Screens from Act 1 Scene 3 and Scene 4.

Figure D.5: Screens from Act 1 Scene 4 and Scene 5.


Figure D.6: Screens from Act 1 Scene 5.


Figure D.7: Screens from Act 1 Scene 5, Scene 6 and Act 2 Scene 1.

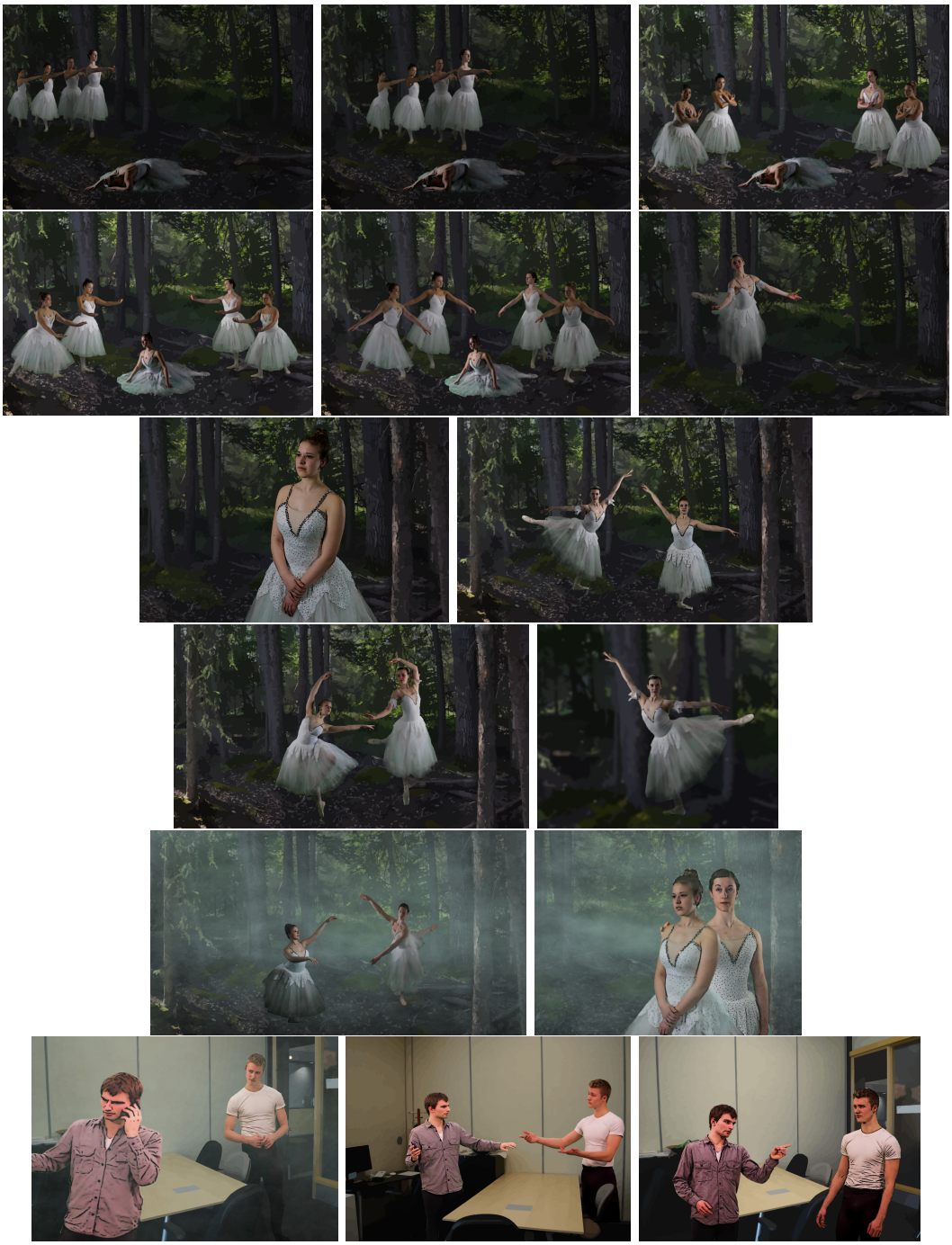


Figure D.8: Screens from Act 2 Scene 1 and Scene 2.

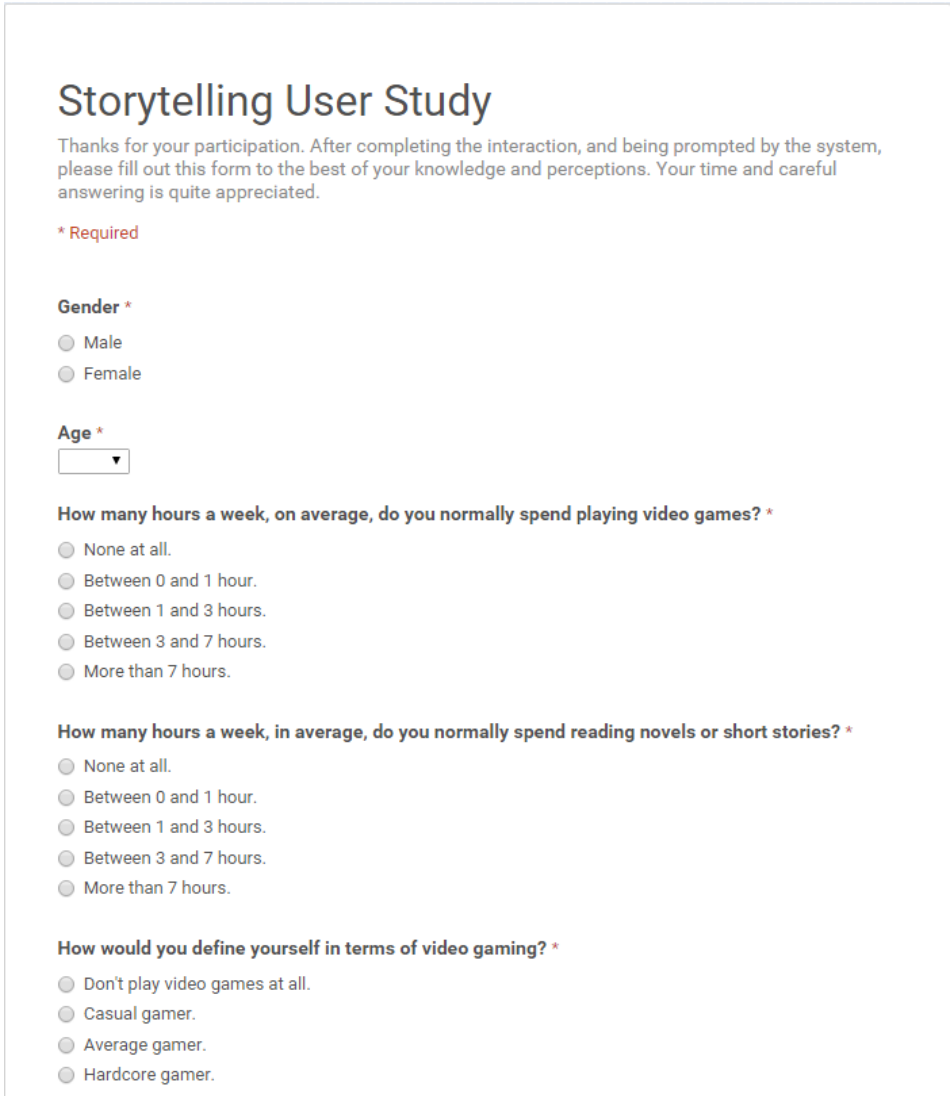
Figure D.9: Screens from Act 2 Scene 2, Scene 3, Scene 4.

Figure D.10: Screens from Act 2 Scene 5 and endings.

Figure D.11: Screens from endings.

# Appendix E

# User Study Questionnaires



## Storytelling User Study

Thanks for your participation. After completing the interaction, and being prompted by the system, please fill out this form to the best of your knowledge and perceptions. Your time and careful answering is quite appreciated.

* Required

**Gender** *

- Male
- Female

**Age** *

**How many hours a week, on average, do you normally spend playing video games?** *

- None at all.
- Between 0 and 1 hour.
- Between 1 and 3 hours.
- Between 3 and 7 hours.
- More than 7 hours.

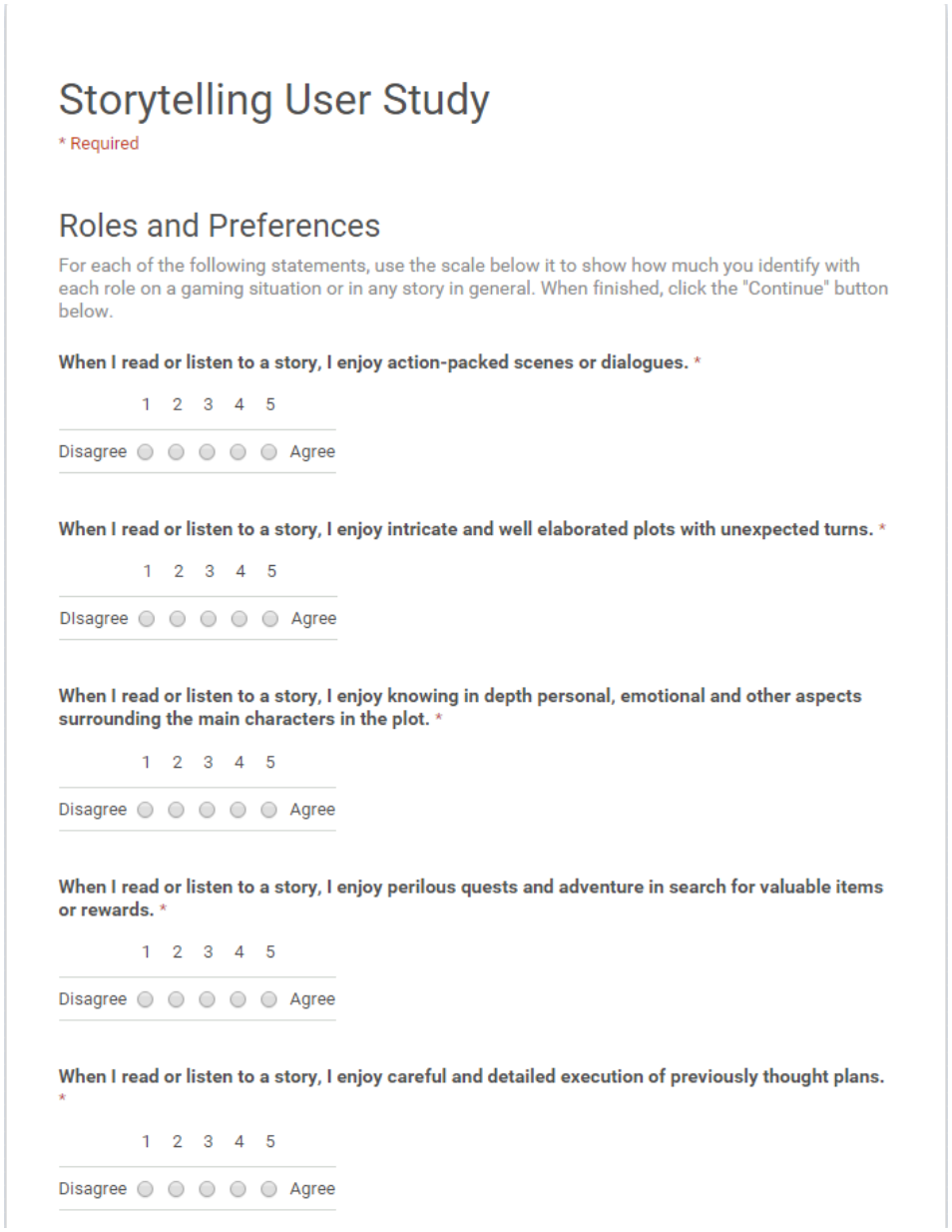
**How many hours a week, in average, do you normally spend reading novels or short stories?** *

- None at all.
- Between 0 and 1 hour.
- Between 1 and 3 hours.
- Between 3 and 7 hours.
- More than 7 hours.

**How would you define yourself in terms of video gaming?** *

- Don't play video games at all.
- Casual gamer.
- Average gamer.
- Hardcore gamer.

Figure E.1: Questionnaire part 1.



# Storytelling User Study

* Required

## Roles and Preferences

For each of the following statements, use the scale below it to show how much you identify with each role on a gaming situation or in any story in general. When finished, click the "Continue" button below.

**When I read or listen to a story, I enjoy action-packed scenes or dialogues.** *

1 2 3 4 5

Disagree ○ ○ ○ ○ ○ Agree

**When I read or listen to a story, I enjoy intricate and well elaborated plots with unexpected turns.** *

1 2 3 4 5

Disagree ○ ○ ○ ○ ○ Agree

**When I read or listen to a story, I enjoy knowing in depth personal, emotional and other aspects surrounding the main characters in the plot.** *

1 2 3 4 5

Disagree ○ ○ ○ ○ ○ Agree

**When I read or listen to a story, I enjoy perilous quests and adventure in search for valuable items or rewards.** *

1 2 3 4 5

Disagree ○ ○ ○ ○ ○ Agree

**When I read or listen to a story, I enjoy careful and detailed execution of previously thought plans.** *

1 2 3 4 5

Disagree ○ ○ ○ ○ ○ Agree

Figure E.2: Questionnaire part 2.

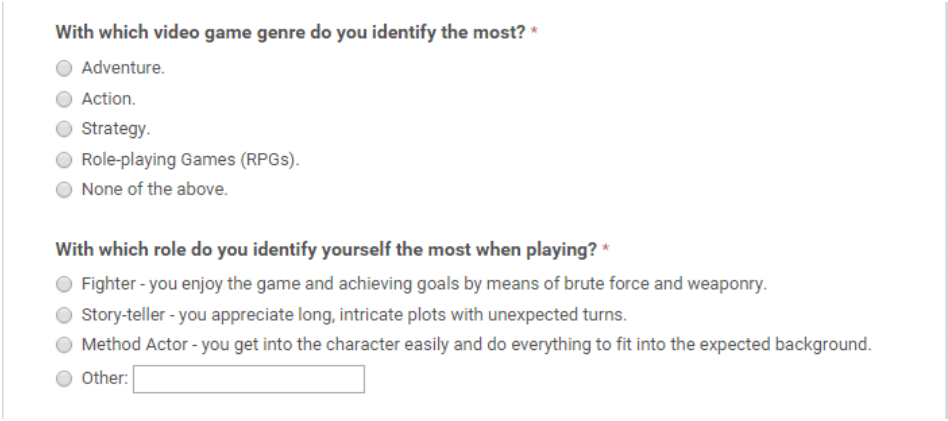



Figure E.3: Questionnaire part 3.

# Storytelling User Study

* Required

## Assessing the Experience

For each of the following statements, use the scale below it to show how much you agree or disagree with what it says. All these items are related to the interaction you just had the system. When finished, click the "Continue" button below.

**The story experience was interesting.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The story experience was believable (in its own context)** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The story experience is consistent with itself (no contradictions in the plot).** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The story experience experience kept me immersed.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The story experience was gratifying.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

Figure E.4: Questionnaire part 4.

**The story experience was rewarding.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The story experience was amusing.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The story experience was exhilarating.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The story experience was thrilling.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The story experience was exciting.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The story experience was melancholic.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The story experience was moving.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

Figure E.5: Questionnaire part 5.

**The story experience was appealing.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The story experience was pleasing.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The story experience made me feel proud.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The story experience made me feel competent.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**My inputs had considerable impact on the events in the story.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**I had the feeling that I could affect directly something on the screen.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**The consequences of my inputs were clearly visible.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

Figure E.6: Questionnaire part 6.

**The consequences of my inputs were clearly visible.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**I could recognize which events in the story I have caused with my inputs.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**My decisions clearly influenced how the story went on.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**I discovered how my earlier actions influenced what happened later in the story.** *

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | ○ | ○ | ○ | ○ | ○ | Strongly Agree |

**Mention any elements that made you like or dislike the story**

Figure E.7: Questionnaire part 7.

# Storytelling User Study

* Required

## Assessing the Experience

All of these questions are related to the interaction you just had the system. When finished, click the "Continue" button below.

**Report which emotion you experienced in each story event.** *

| | Distress (felt extremely unhappy) | Fear (felt unhappy) | Hope (felt content) | Joy (felt extremely happy) |
|---|---|---|---|---|
| Dance class | | | | |
| Giselle gets the lead role | | | | |
| At the party | | | | |
| Albrecht proposes | | | | |
| Accident | | | | |
| Giselle wakes up in Myrtha's realm | | | | |
| Giselle experiences flashbacks with Marie (first wili) | | | | |
| Giselle experiences flahsbacks with Carla (second wili) | | | | |
| Giselle experiences flashbacks with Myrtha | | | | |
| End | | | | |

Figure E.8: Questionnaire part 8.

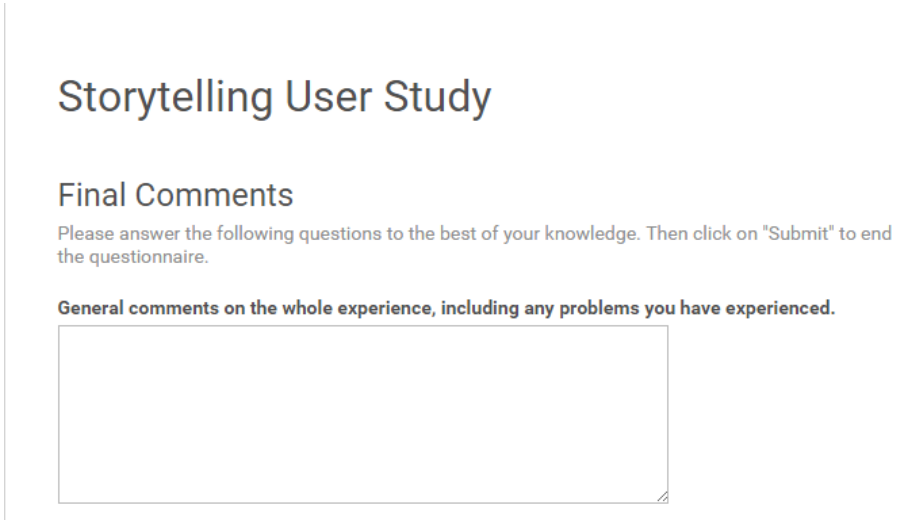



Figure E.9: Questionnaire part 9.