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Towards Believable Characters in the Virtual Storyteller

by

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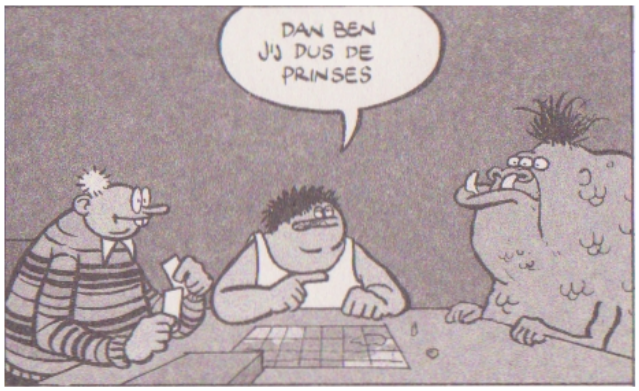
I want to be the Orc
I'll be the dragon



So that makes you the princess

Abstract

The Virtual Storyteller is a multi-agent automated story generation application that can generate stories by simulating a virtual world in which character agents pursue their goals. The goal of this research has been to make the characters of the Virtual Storyteller more interesting and believable and also to give the reader of the stories more insight in the mind of the characters.

This thesis describes a new form of goal management for the Character Agents of the Virtual Storyteller. Where previously, characters chose randomly between possible goals, this work proposes an implementation solution (based on the PSI theory) to the goal of providing the characters with self-motivation in order to enable them to make informed decisions based on their characteristics. Personality traits and interests have been identified as the main factors of self-motivation and have been incorporated in a motivational goal management algorithm.

In addition to the character's self-motivation, the Virtual Storyteller's fabula model has been extended to incorporate a dramatic choice data structure, which embodies an interesting branching point in the storyline where characters are posed with choices that are often exclusive. Dramatic choice has been integrated in the Virtual Storyteller's fabula structure allowing the presentation layer to incorporate such situations in the Virtual Storyteller's stories in the future. The stories will then be able to communicate a character's choices and motivations to the reader.

Preface

Starting a story with the ending might seem unorthodox, but with the storytelling experience I've gained during this research I feel confident to do it anyway. For writing this preface really marks the end of an era, the end of me being a student at the University of Twente. It's been a number of years since I started studying Computer Science in Enschede and I really have enjoyed this period, the years doing the master Human Media Interaction especially; time really has flown by.

First and foremost I want to thank my parents for enabling me to experience this period of my life without any pressure whatsoever and also for encouraging me to enjoy it to the fullest. You guys are unique friends and are very important to me.

To my girlfriend Roos and all people close to me, whom I will try to catch in the term 'social environment' (you know who you are!): you are a big part of the reason it took so long for me to graduate. This is by no means meant as an accusation; thanks a lot for your part in making the past years the best years of my life so far.

Of course also a big 'thank you' to my graduation committee, Ivo, Mariët and Dirk for being able to stay motivated to keep on steering this student that seems to take forever to finish his final project in the right direction. The thesis that now lies before you is also your achievement. Ivo, I really appreciate your role along the way, and while I could elaborate on this statement, the fact that there were moments that I forgot you were in my graduation committee says it all for me. Thanks for that.

Jasper Bragt
Enschede, July 1st, 2010

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1 Introduction

Throughout human history stories have played important social roles. By means of stories people have been trying to make sense of the world around them, as with so-called 'creation stories'. Creation stories try to explain how the earth has come to be and how humanity was created. Famous examples of such stories are the myths and sagas that originated from ancient Greece and for instance the book Genesis of the Christian bible.

Stories can also be metaphors used to pass knowledge and to communicate morals and ethics. Stories like these are very powerful ways of enveloping knowledge. Just telling someone that lying constantly will eventually result in loss of trust has a different impact than telling the famous story "The boy who cried wolf", especially with younger people and children who cannot yet relate to their own experiences in such matters.

Of course, stories are not bound to have a higher purpose or hidden meaning. The stories we use every day are for the large part a recounting of events we have experienced. Aristotle says in "Poetics" that storytelling is what gives us a shareable world. The key word there is 'shareable', because it is through the use of story that we communicate our subjective experience. Sharing our experiences and listening to those of others allows us to connect and identify with others.

Over time, the possibilities for conveying stories have grown. That which initially started with the scribbling on cave walls now exists as blogs on the internet. Computers play a very prominent role in our society nowadays and offer us new ways of story representation, but can computers tell stories themselves? The field of automated story generation explores the possibilities of computer based creation of stories.

The Virtual Storyteller is a story generation application that simulates a virtual story world in which characters 'live'. Planning and executing the pursuit of goals by the characters forms the basis for the stories the Virtual Storyteller produces. In order to contribute to the Virtual Storyteller, this research will explore the ways in which the characters of the application can be made more believable. As we will see, self-motivation will be identified as a very important aspect of believable characters and appears to be a basis on which other aspects of believability, such as emotion, thrive.

This chapter will describe the context of automated story generation which will be illustrated by discussing a number of earlier story generation applications. Next we will turn our attention to the Virtual Storyteller and will describe the approach it uses for the generation of stories. After that, the goal of this research will be formulated and with it a methodology will be presented.

1.1 Automated Story Generation

Given the importance of stories it is no surprise that they have long been of interest to researchers in the fields of Artificial Intelligence, Narrative Theory,

Psychology and Computer Science. With automated story generation systems we seek to model the knowledge and processes necessary to produce a story [27]. Work concerning automated story generation produced numerous story generation applications over time. Bailey [4] has divided this work into three major groups: author models, story models and world models. More recently, Mateas and Sengers [27] have categorized story generation systems as author-centric, story-centric, or character-centric[1].

Author-centric systems model the thought processes of an author that contribute to the eventual creation of a story. The stories that result from these systems mostly start with determining an authored plot (storyline), after which characters and settings are tailored to adhere to this plot. In other words, the stories are held together by and adhere to some pre-defined (by the author) requirements, like the storyline. The details are then filled in at runtime by the characters.

Applications within the story-centric approach focus on an abstract representation of the story structure, such as a grammar, independent of the story contents. For example, a story can be modeled as having an introduction, a middle part and an end. A story-centric system's stories should then adhere to this story structure and start with some form of introduction.

With the character-centric approach, the story is mainly formed by events, the characters and the things they do inside the story world (also referred to as the 'fabula' of the story). The eventual story then results from (a selection of) the fabula's content. In contrast with the author-centric approach, with character-centric systems the characters are largely autonomous and are not bounded by a pre-defined storyline. As we will see, the Virtual Storyteller is a character-centric story generation application.

Numerous story generation applications have been developed in the past decades. While each of these systems has been formed according to the designer's personal view on stories, they all can be classified as belonging to the aforementioned major categories of story generation systems. Below, some illustrative examples of story generation applications and the approach they use are discussed. For a more complete overview of storytelling application history I refer to earlier work of Sander Faas [15] and Sander Rensen [33].

1.2 Example Story Generation Applications

An excellent example of an author-centric story generation application is Minstrel, developed by Scott Turner in 1994. Turner looks at automated story generation as a process of creative problem solving [46]. Minstrel's stories are about one-half of a page in length concerning King Arthur and his Knights of the Round Table and intend to reflect some moral or message (see figure 1).

The part of the system that makes Minstrel author-centric is its case-based reasoner which matches the story state with pre-authored rules. Minstrel interprets

[1]These categories are identical to Bailey's categories except that Bailey calls character-centric systems world models.

```
THE KNIGHT AND THE HERMIT

ONCE UPON A TIME, THERE WAS A HERMIT NAMED BEBE
AND A KNIGHT NAMED CEDRIC. ONE DAY, CEDRIC WAS
WOUNDED WHEN HE KILLED A DRAGON IN ORDER TO
IMPRESS THE KING. BEBE, WHO WAS IN THE WOODS
PICKING BERRIES, HEALED CEDRIC. CEDRIC WAS
GRATEFUL AND VOWED TO RETURN THE FAVOR.

LATER, BEBE BELIEVED HE WOULD DIE BECAUSE HE SAW
A DRAGON MOVING TOWARDS HIM AND BELIEVED THAT IT
WOULD EAT HIM. BEBE TRIED TO RUN AWAY BUT
FAILED. CEDRIC, WHO WAS IN THE WOODS, KILLED A
DRAGON AND SAVED BEBE.

MORAL: "A FAVOR EARNED IS A FAVOR RETURNED"
```

Figure 1: An example story of Minstrel

actor (or character) goals as problems and tries to solve these goal-problems by modifying them into slightly different problems. These modified problems are then compared to data inside a knowledge base of earlier encountered problems or other pre-authored problems. The found solution can then be adapted to conform the original problem.

A recent example of a character-centric story generation application is FearNot! (Fun with Empathic Agents Reaching Novel Outcomes in Teaching) [2][3]. FearNot! is a so-called interactive pedagogical drama (IPD) and was developed to address the issue of bullying at schools. FearNot! has graphically embodied characters that act out typical bullying scenarios in a virtual environment. Through a character's embodiment the internal state of the characters is communicated to human users which enables them to empathize with the ones involved in bullying scenarios. The characters themselves are autonomous, pursuing their goals and making plans of action. By relating their goals to the environment the characters can experience emotion, such as fear when the chances of avoiding getting hurt are very slim. FearNot's interactivity consists of the human user being an 'invisible' friend of the bully victim. After a FearNot! episode of bullying, the user can give advice to the victim character, which results in adjustments of the character's goal importances so that it will react differently (and heed the user's advice) in the next episode.

A story generation application that follows an intermediate approach and contains both author-centric and story-centric components is Façade [25]. Façade is an interactive drama, set in a first person 3D environment. The story takes place inside the apartment of a married couple, apparently old friends of the player. The player can move around freely, interact with every object and communicate with the couple through typing natural language. Although the behaviour of the two embodied agents is scripted (which is an author-centric aspect), it is done in such an extensive way that the player's actions have significant influence on the events that occur and one is not likely to encounter two exactly the same

situations. Also, in contrast with other authored interactive stories, there are no explicit branching points where the player has a choice to go a certain way.

Effectively, Façade appears as a simulation with autonomous characters influenced by a player. However, these simulations are structured by rules which are monitored by a drama manager (which embodies the story-centric aspect). Depending on the player's actions, the drama manager decides how to update these rules. It decides, for example, to pose a dramatic question or situation to the player. Another decision could be to wait and listen to the player's reaction to the situation.

At a high level, Façade can be viewed as a complex graph, but with so many possible paths that it cannot be seen as structured narrative anymore. In other words, because the amount of authoring is vast, the possibilities are so numerous that it almost becomes impossible to traverse the complete graph.

One of the most famous among the first story generation applications is TALE-SPIN, developed by James Meehan in 1976. TALE-SPIN follows the character-centric approach and generates stories based on a simulation of a small number of characters acting inside a virtual story world. The characters are assigned goals after which TALE-SPIN tells the reader what is happening. Characters inside the TALE-SPIN micro-world can be in thirteen different emotional states, which all affect their choice of behaviour. TALE-SPIN is also interactive; the reader is asked to make a decision at certain points in the story (see figure 2).

```
******** WELCOME TO TALE-SPIN ********
CHOOSE ANY OF THE FOLLOWING CHARACTERS FOR THE STORY:
1: BEAR
2: BEE
3: BOY
4: GIRL
5: FOX
6: CROW
7: ANT
8: CANARY
* 1 2

ONCE UPON A TIME SAM BEAR LIVED IN A CAVE. SAM KNEW THAT
SAM WAS IN HIS CAVE. THERE WAS A BEEHIVE IN AN APPLE TREE.
BETTY BEE KNEW THAT THE BEEHIVE WAS IN THE APPLE TREE.
BETTY WAS IN HER BEEHIVE. BETTY KNEW THAT BETTY WAS IN HER
BEEHIVE. THERE WAS SOME HONEY IN BETTY'S BEEHIVE. BETTY
KNEW THAT THE HONEY WAS IN BETTY'S BEEHIVE. BETTY HAD THE
HONEY. BETTY KNEW THAT BETTY HAD THE HONEY.

- DECIDE: DOES BETTY BEE KNOW WHERE SAM BEAR IS?    * NO
- DECIDE: DOES SAM BEAR KNOW WHERE BETTY BEE IS?    * YES
```

Figure 2: An example story of TALE-SPIN

Meehan's theory of stories is a clear and simple one: "*a story is about a problem and how it gets solved*" [48]. This does not differ that much from Turner's point of view when he created Minstrel. However, the main point of critique on TALE-SPIN, also uttered by Turner, is that often the generated stories have no point and just ramble on about some character's actions and goals while there is no story structure.

In general, it is believed that character-centric systems tend to result in stories with strong character-believability but weak plot coherence, while author-centric systems result in stories with strong plot coherence but not necessarily sufficiently believable characters [34]. Intermediate approaches, like Façade, are possible, but still require a lot of authoring before a believable simulation that does not seem pre-scripted, can be run.

1.3 The Virtual Storyteller

The Virtual Storyteller (from now on referred to as VST) generates stories by simulating a story world. The stories result from the behaviour of the characters and events inside this virtual world, which defines it as a character-centric story generation system. The architecture of the VST (shown in figure 3) consists of three components: simulation, virtual environment (which together form content generation) and presentation.

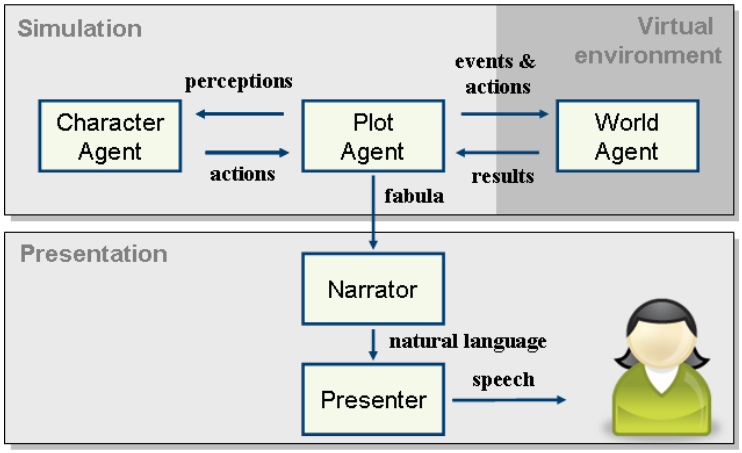


Figure 3: The architecture of the Virtual Storyteller

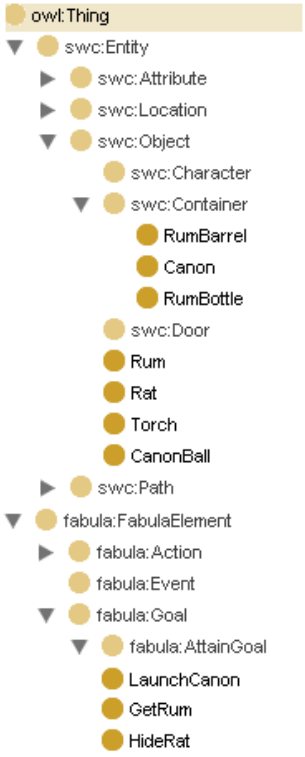
As can be seen in the figure, the VST's content generation component is a multi-agent system consisting of three different types of agents, each with different responsibilities and communication roles. The World Agent's main responsibility is to build up and keep track of the virtual world and everything in it. Different instances of the Character Agent play a role in the story and 'live' and act inside the story world. The Plot Agent gives turns to the characters inside the story, sends them their perceptions and receives their requested actions. Also, the Plot Agent is responsible for creating the fabula structure of the story.

The following sections present a short overview of some parts of the internal workings of the VST that are relevant in the context of this research and which will be referred to later on in this thesis. The overview is concluded with an example story generated by the VST.

1.3.1 Implementation Details

The VST architecture is implemented in Java and uses a Prolog knowledge base that contains all information about the characters, objects and relationships in the virtual story world. Knowledge is represented by RDF triples, which have the form `(subject, predicate, object)`, for example `(Character, hasRole, Pirate)` or `(Pirate, locatedAt, Deck)`.

The semantics of this knowledge is defined by three OWL ontologies: two general ontologies and one ontology that is specific for the story domain. The `Fabula` ontology defines fabula concepts, like `Goal`, `Event` and `Perception` (more about fabula in section 1.3.3) and the `StoryWorldCore` contains a basic story world with object classes and relationships that are thought to be used a lot, for instance roads, locations, and relations like `LocatedAt` and `ContainedBy`. The domain-specific ontology imports both general ontologies and extends them with domain-specific content (see figure 4).




```
# Some rum
:oRum_1
    a   psj2:Rum ;
    .

# A rumbottle on deck
:oRumBottle_1
    a   psj2:RumBottle;
    swc:at :oDeck_1;
    swc:contains :oRum_1;
    swc:hasAttribute psj2:full;
    rdfs:label "a full rumbottle";
    .

# A canon in the hold
:oCanon_1
    a   psj2:Canon;
    swc:at :oHold_1;
    swc:contains :oRum_3;
    rdfs:label "the canon";
    .
```

Figure 4: Part of a domain-specific ontology (left) and part of the setting(right)

Using instances of the ontological classes during simulation requires a definition of individuals in the setting (also see figure 4).

Actions and goals for characters in the VST are created through so-called schemas. Schemas are Prolog predicates containing a list of information such as preconditions that have to be true in order to allow for execution of an action. the schema's type links the schema to the ontological class as defined in the ontology.

```
% ----------------------------------------
% GetRum
% ----------------------------------------
% Goal for getting rum
% PRE:  there are a pirate and a bottle, the bottle is filled with rum
% SUC:  the pirate has the bottle

goal_schema([
    type(psj2:'GetRum'),
    arguments([agens(Agens), patiens(Patiens), R]),
    preconditions([
        condition(true, [
            fact(Agens,   swc:hasRole,          psj2:'Pirate'),
            rule(Patiens, owlr:typeOrSubType,   psj2:'RumBottle'),
            fact(Patiens, swc:contains,         R),
            rule(R,       owlr:typeOrSubType,   psj2:'Rum')
        ])
    ]),
    success_conditions([
        condition(true, [
            fact(Agens,   swc:has,              Patiens)
      ])
    ])
]).
```

Figure 5: A goal schema for the goal `GetRum`

In addition to the knowledge base, the Prolog side of the VST also contains a lot of predicates in order to query the knowledge base, for example `goalUrgency`, which returns the urgency as stated in the goal schema that is queried.

Let us illustrate the above with an example based on information shown in the figures. To enable a pirate character in the VST to undertake the goal `GetRum`, we need some rum and the goal to get rum. In the domain ontology we create the class `Rum` to create the rum. In the setting we make an individual of this class. We then create the class `RumBottle`, again make an individual of this in the setting and state that the rum is contained by the bottle. This is consistent with the ontology because we have defined the class `RumBottle` as a subclass of the `Container` class and because a relationship `contains` is defined in the ontology that has containers as its subject. We then create the class `GetRum` to represent the goal in the ontology. After that we can create the goal schema shown in figure 5. With the creation of rum and a rumbottle we have fulfilled the preconditions of the goal schema which enables the character to adopt the goal.

1.3.2 Goal Management

The behaviour of the characters in the VST's stories is driven by goals. Characters have goals and can make plans to attain these goals. In the goal schema the author specifies the following:

- preconditions; conditions that have to be met to enable this goal
- success conditions; conditions that have to be met to determine goal attainment
- failure conditions; conditions that have to be met to determine goal failure

In short: the preconditions determine when the goal *can be adopted* by a character and the succes- and failure conditions determine when the goal is dropped.

Another data structure, the goal selection rule, can be used to specify certain situations in which a goal *should be adopted*. For instance, a goal to jump overboard has a precondition to be on a ship. Since this is a goal that is normally not pursued without a good reason, we can specify a goal selection rule that only allows adoption of this goal when the ship is on fire. This condition can also be used as a precondition of the goal, but is in essence not a real requirement for jumping overboard. Goal selection rules allow for different reasons to adopt a goal when the preconditions are satisfied.

The adoption of goals usually takes place in two general situations: at the start of the story and after achieving a goal. Having adopted a goal does not imply that the character immediately starts pursuing this goal; the character merely shows the intention to attain this goal in the near future. A list of adopted goals functions as a 'to-do list' of the character. Of all the adopted goals, one goal is chosen as *active goal*. This is the goal the character is pursuing right now and for this goal a plan is made and executed.

1.3.3 Fabula

The fabula is formed by the Plot Agent which logs everything that happens during content generation in the form of a story-graph. Figure 6 shows a story graph that represents a goal to greet someone. The character Linda has the goal to greet another character named Otto, which motivates her choosing and performing the action `Greet`. Successful execution of this action gives both characters a perception of the performed action and also the belief Linda has performed the greeting action. Upon completion of the `Greet`-goal the outcome is added to the graph.

Every event in the story world is captured into a so-called fabula element as a node in the graph. The nodes are connected by causal links, which define order and meaning to the event sequence. In addition to the actual event and when it took place, each fabula element has a certain type and contextual information which will later be important when the story is to be told.

The following fabula element types are currently used: `Settings` (states of the world), `Events` (things that happen unintentionally), `Perceptions` (things a character sees), `Internal Elements` (cognitions, emotions, beliefs), `Goals`

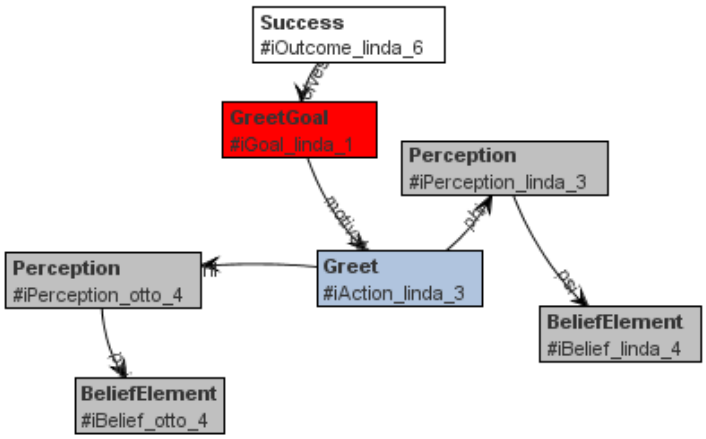


Figure 6: An example of a fabula graph

(things a character wants to reach or maintain), `Actions` (things a character does) and `Outcomes` (of actions and goals).

The causal links describe how the elements are related. When an event in the story world has an effect which makes the preconditions of a goal become true, then this event *enables* the goal. In addition to *enables*, other relationships that can exist between fabula elements are *psychologically causes*, *physically causes* and *motivates*. Figure 7 presents an overview of this information.

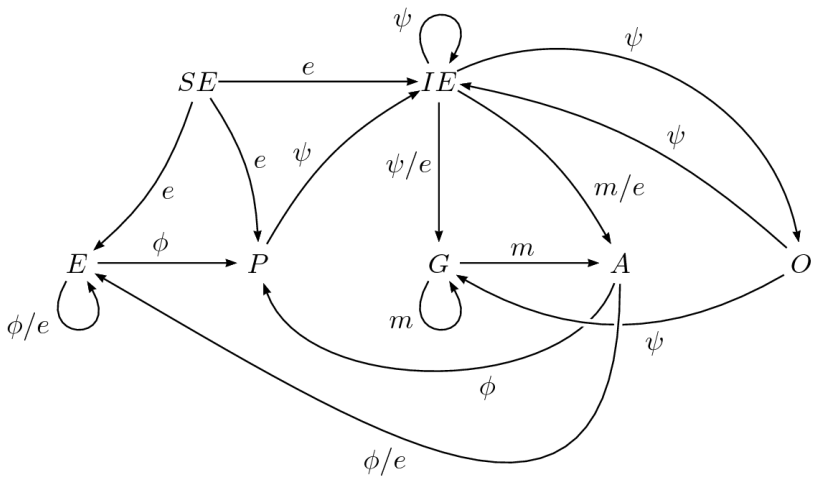


Figure 7: Overview of fabula elements and causalities

The fabula is eventually converted to natural language by the presentation component of the VST. This is done by interpreting the different types of fabula elements and causalities which eventually results in output in the form of an actual story.

1.3.4 Example Story

Below, an example of a story generated by the Virtual Storyteller is presented. The story has been manually translated from Dutch to English[2].

Once upon a time there was a pirate, who was called Billy Bones. He was in the hold of his ship. The water supply was empty and he wanted to fill it. Therefore he opened the hatch. With a ladder the pirate walked to the deck. With the ship he sailed to an island. After he had gone ashore at the island, he filled the water supply with water from a pond.

1.4 Research Goal

At the moment, the VST's story generation is mainly based on presenting (by the author) certain goals and a world state to the characters, after which the characters try to attain their goals in a simulation. From the traditional viewpoint of Artificial Intelligence, the characters are problem solvers without deliberation other than their planning algorithm. Compared to characters in more elaborately written stories, like novels (which are of course far out of reach of the current possibilities in automated story generation), the characters in the VST's generated stories are not very appealing.

In general, the goal of my research is to find a way to make the characters of the VST more interesting. Researchers in the area of believable characters (among which Reilly [32], Loyall [23], Paiva [21] and Riedl [34]) indicate that story characters should be able to reason about how they feel about certain events in the story world and express emotion. This research, as we will see, also points out that personality and self-motivation have a strong influence on the (expression of) emotional behaviour of a character.

Therefore, the main goal will be to provide the VST characters with personality and self-motivation as a drive behind the goals they undertake. This should make them more interesting and recognizable, because it enables talk about certain characteristics of a character in addition to merely observing what it does. The resulting motivational goal management is also likely to lead to more believable behaviour compared to the goal selection that exists now, because we can relate the choices a characters makes during the story to its motivations.

For the reader to understand how a character reaches a certain decision, it is likely that (part of) the character's personality and motivations have to be expressed in some way during the story presentation. Without this knowledge it could seem that a character's behaviour still does not differ all that much from random goal selection. For now however, I will be working under the assumption that the reader is able to deduce a character's most relevant characteristics from the story. According to Gerrig [16], the audience actively models the characters

[2]The original text is: *Er was eens een piraat, die Billy Bones heette. Hij was in het ruim van zijn schip. De watervoorraad was op en hij wilde hem vullen. Daarom opende hij het luik. Met een ladder liep de piraat naar het dek. Met het schip voer hij naar een eiland. Nadat hij bij het eiland aan land was gegaan, vulde hij de watervoorraad met water uit een vijver.*

in a story and forms hypotheses about the traits that a character possesses, to evaluate future actions the character makes. The knowledge of the fact *that* characters use self-motivation, together with observing motivated choices combined with earlier decisions and possible other story context, could therefore already provide the reader with enough information.

1.4.1 Methodology

To be able to create story characters for the VST with personality and self-motivation, we have to investigate how such properties can be modeled and also how to apply them in a specific story domain. Since the VST currently focuses on pirate stories, we will be analyzing existing pirate stories to get a general idea of how motivation and personality surface in such stories. This will provide us with information about which motivations are typical for pirates and what role they can play in influencing pirate behaviour. We then have to look at whether and how personality and motivation would fit in the architecture of the VST and, after that, implement them and build a goal management process that incorporates them.

To be able to evaluate the implementation, we should have a close look at both the characters' decision process and the authoring process that is needed to enable motivational goal management in the VST. The implementation should work correctly and authors working with the VST should be able to work with character properties such as personality traits and interests with relative ease.

By using scenarios with various authored characters with different personalities and motivations encountering several choices, it can be verified whether these requirements are met. More importantly, these scenarios can show whether the enhanced characters are really more interesting and believable than before. We will see whether the character's choices are in line with their personality and motivations and can identify which effect the authored characteristics have on the simulation. Finally, we will look at the stories that result from the scenarios to identify in what way they are different than before and discuss whether they are better or show the potential to become better in the near future as a result of this research.

2 Analyzing Narratives

By narrative, we mean a certain type of artistic and social expression (e.g. written, spoken, poetry, prose, images, movies, song, theater or dance), where a kind of imitation of real events is involved [44]. The story, which is easily confused with the idea of narrative, will refer to the succession of events that happen in the world represented by the narrative. This distinction between the two is important, because it means that a story can have several different narratives representing it. In other words: there are multiple ways of telling the same story.

Since Aristotle, narratives are the subject of analytic research focused on narrative structure and meaning. Aristotle performed his story analysis with the idea that the structure of the plot is essential for constructing narratives. According to him, a good story consists of a beginning, a middle part and an ending. This may not sound very surprising, but being the first to think about such a narrative structure, Aristotle laid the foundation of modern narrative theory with this research[3].

In the following sections I will first give a brief overview of the research that has been done in the area of narrative structure. This, in addition to providing some general interesting knowledge related to stories, will contribute to better understanding the architecture of the Virtual Storyteller. After that, I will zoom in on this research's goal of making the characters of the VST more interesting by identifying what story elements make a story interesting and what aspects believable characters should have.

2.1 Narrative Structure

The narrative structure identified by Aristotle (story = begin + middle + end) can be interpreted as a story grammar, albeit a very general one. A story grammar is some kind of formula that, once the variables are filled in, will produce a story. Since Aristotle, many researchers have come to believe that stories can indeed be captured in grammars. This grammar-approach of analyzing stories has been further developed by the work of Vladimir Propp. In his "Morphology of the Folktale" [29], which he completed in 1968, Propp performs an analysis of one-hundred and fifteen Russian folk tales. In his research he identifies a number of constant elements in a tale, better known as Propp's functions (which were later refined by Greimas [17]), which included:

1. Disruption of a state of equilibrium
2. Arrival and mission of hero
3. Trial of the hero
4. Task of the hero accomplished
5. Return to original state

[3]Narrative theory is also known as narratology

While much research has been conducted about story grammars in the area of story generation, the problem with the grammar-based approach is that the grammars are derived from stories, instead of the other way around. A story can satisfy a grammar, but this only works to a certain extent; the perfect grammar will be too complex, while a less complex grammar will not be able to account for all possible stories. Usually, an abstraction is specified for the domain in which the grammar is to be used to generate stories from.

Another way of structuring a narrative involves identifying different layers, where each layer is responsible for a different aspect of a narrative. The Virtual Storyteller's architecture consists of three separate layers (as can be seen in figure 3 in section 1.3) based on three layers of narrative identified by Bal [5]:

- Fabula layer: the actual sequence of events that take place in the story world.
- Story layer: a part of the fabula, selecting characters and/or viewpoints through which to tell parts of the fabula.
- Text layer: a narrative is presented to the reader/listener/viewer and this can be done in multiple ways for the same (part of the) fabula.

With the VST, autonomous character behaviour is logged (fabula layer), but only a selection of everything that happens during simulation is considered part of the actual story (story layer). This selection of the fabula is then interpreted by the narrator, which presents the narrative to the user of the VST (text layer).

Traditionally, narrative involves two components: a 'what' (what happened) and a 'how' (how it is presented). The 'what' of a narrative refers to the narrative's content. This concerns everything that happens inside the story world and is known as event structure or *fabula*. But simply saying 'this happened, then that and then the next thing', does not automatically make a narrative. The 'how' has to do with the way in which the narrative is presented and is called discourse, or *sjuzet*. As Oatley puts it: "*A story* [as a type of narrative] *depends on creation of a discourse structure in which just some events are selected from the flux of possible happenings, and presented at rates, in orders, and in ways, that are not the same as the event structure*" [26, p.57].

2.2 What Makes Stories Interesting?

Now we know the basics of narrative theory and understand roughly how the VST produces its stories. To some extent, this also gains insight in where to look, should we want to change something in the process of creating these stories. Should we want to change story content, like character behaviour for example, this firstly involves the fabula layer, but we should also think about how we want to see this change appear in the resulting story text.

Knowing *where* to change or add things is useful, but not without knowing *what* to change or add and in what way. The following sections try to identify the ingredients that make a story interesting. Because the reader's engagement in the story seems to be an important aspect of interesting stories, we will start

by looking at the emotions associated with the reader of a story and how they come to be. After this we will take a closer look at story characters.

2.2.1 Internal & External Emotions

To be interesting for the reader, a story needs to have a certain dramatic value; it needs to have a point, a reason to be told. Stories, interactive or otherwise, are most effective when they engage the reader [14]. An engaging story will provide the reader with a certain feeling about it, distinguishing it from an objective description of events like a common weather report. But what exactly is the role of these feelings, the emotions that are associated with a story? Before we can address this question, we first have to identify in what form emotions can be encountered in the context of stories.

Oatley [26] identifies the following types of emotions that can arise in readers when they read stories (as is also shown in figure 8)

- external emotions, which are emotions about the story itself.
- internal emotions, which are emotions that result from the reader engaging in the story world.

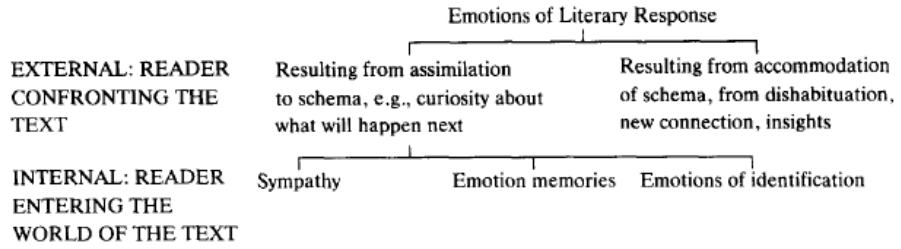


Figure 8: Oatley's classification of reasons explaining emotion-occurence in the reader of a story

External emotions evoked in the reader are about some part of the story and relate to concepts like suspense, curiosity or surprise. These feelings have to do with the story line; the reader wants to know what will happen next or gains new insights on a mystery and feels happy about it. Story content can also affect external emotions. The reader will feel more immersed in a pirate story when the pirates are dressed like pirates and behave like pirates. These aspects of the story content are evaluated by the reader without entering the story world, which can be illustrated by opinions like *I liked the story and especially the bold character, but the ships looked a bit silly and that one pirate did not even behave like a pirate at all!*'.

Internal emotions go beyond the story-level; they have to do with elements inside the story world, for example with the emotional experiences of the characters. The reader gets immersed in the story through the story drama and is invited to establish an emotional bond with the characters through identification, empathy and emotion memories.

According to Oatley, empathy[4] creates a mental link to another person, which can be described as feeling certain emotions relating to the situation the characters are in. With empathy, readers are observers who simulate the goals and plans of the characters in a story, and then experience emotions due to the succeeding or failing of them [40].

Identification is the process where someone places themselves in the position of someone else, experiencing the behaviour and perceptions as though they were their own. Important internal emotions are caused by identification of the reader with a character.

To illustrate the concepts of identification and empathy, consider the following example: an important character is hanging around unknowingly while the bad guy sneaks up on him. Observing the situation, we know more than the character does. Any feelings like fear or suspense are brought forward by empathy. Identification cannot explain these types of feelings because we would be placed in the character's situation and would feel like he would feel: unaware of someone sneaking up on us.

Internal emotions can also be associated with emotion memories. For these emotions to be evoked, the reader has to draw on his own experiences that are comparable with those the character inside the story is experiencing. Stated as such, they can be seen as some kind of identification, but more focused on the situation instead of the character in that situation. For this to be possible, the story should offer recognizable situations for its readers. While emotion memories are mostly evoked non-deliberately, authors that do want to deliberately make use of this type of emotions, usually need to know much about their type of reader.

Summarizing the above, we have seen that external emotions are mostly concerned with the presentation aspect (what knowledge of the mystery will be presented when, to create maximum suspense?) and choice of content of storytelling. Internal emotions result from events inside the story world, of which character behaviour is a big part. A lot depends on the reader being able to establish an emotional bond with the story characters through identification and empathy. Emotion memories seem less useful in the context of this research, because they are drawn from personal experiences of the reader and can therefore not be included in a general design.

2.2.2 Believable Characters And Self-Motivation

In the previous section, we have identified empathy and identification as the main processes associated with emotions that are evoked in the reader of a story. For an emotional bond to be able to form with the reader, characters have to be *believable*. The term 'believable' is a specific term from the arts to describe characters that 'work'. 'Believable' in this context does not mean honest, convincing, or realistic, but it has to be clear why they express certain behaviour, what drives them [32]. Characters that are believable usually have

[4]Originally 'sympathy', but nowadays more commonly known and used as 'empathy', as proposed by Zillmann in [49]

some kind of personality properties, compatible emotional behaviour and some sort of functionality supporting the story [31].

In earlier work on the VST, Sander Rensen [33] already stressed the importance of emotion in story characters. He based his conclusions partly on the work of Thomas and Johnston [45], who conducted much research in the area of believable characters in Disney films. Loyall [23] identifies several requirements for *believable agents*. Believable agents is the area of overlap between autonomous agents, as researched in traditional AI, and believable characters from the traditional character-based arts, such as animation, film or literature. The term 'believable agents' in the context of this research implies that the autonomous agents of the VST need to be provided with the means to take on the role of the believable character they represent in the story.

From this perspective, with believability on the one side and autonomous agent architecture on the other, Loyall listed his requirements for believable agents. Among these requirements, along with some that are currently beyond the scope of the VST, are the following:

- Personality; details that must be specified to bring a character to life
- Emotion; believable agents must appear to have emotions and expressions of those emotions that are true to their personalities
- Self Motivation; believable autonomous behaviour is not solely a response to external stimuli, but the product of the agent's internal drives and desires
- Appearance of Goals; not random behaviour, but behaviour as a means to an end

About the last mentioned (agent-architectural) requirement, Loyall states that "*All characters in the arts and nearly all creatures in the world appear to have goals. If we want our agents to be as believable, they need to also appear to have goals*" [23, p.23]. Duffy [13] believes that emotions are only experienced in situations of significance to the individual. According to him, the intensity of the emotion is proportional to the degree of importance associated with a particular goal and the degree of threat or promise the situation bears for that goal. The emotion experienced is also affected by the background and information that the individual has about the particular situation [11]. From this we can deduct that a character's emotional behaviour largely depends on the ability to determine what is important to it. This corresponds with Loyall's requirement of self-motivation, which is known in psychological research as the term 'conation'.

Conation[5] refers to the connection of cognition and affect to behaviour. Cognition refers to the process of coming to know and understand certain knowledge, while affect has to do with feelings about that knowledge. In the context of this research, cognition resembles perceptions, (outcomes of) actions and events inside a story world that evoke affect in the form of an emotional reaction. Conation is about a character's motives and is the personal, intentional, planful, deliberate, goal-oriented, or striving component of a character. It is closely

[5]Synonymous with motivation/will/drive, from the Latin verb "conari" which means to attempt or to strive

associated with the concept of volition, defined as the use of will, or the freedom to make choices about what to do [19].

The way of *expressing* emotional behaviour is affected by the personality of the character. As was originally stated by Thomas and Johnston: "*For a character to be that real, he must have a personality, and, preferably, an interesting one*" [45, pp. 19-21]. According to Loyall, believable agents must appear to have emotions and expressions of those emotions that are true to their personalities. Looking back at Loyall's requirements of believable agents, it can be stated that personality and self-motivation have a strong influence on the (expression of) emotional behaviour of a character.

Sloman [38], as one of the pioneers in the field of AI researching emotion, stated that "*Emotions involve complex processes produced by interactions between motives, beliefs, percepts, etc.*" and "*To understand emotions, therefore, we need to understand motives and the types of processes they can produce*" [39, p.1]. Emotions are analyzed as states in which powerful motives respond to relevant beliefs. These motives can lead to or generate goals as well as be goals themselves. In other words, a motive can lead to adoption of some goal and the following course of action is then in turn motivated by the goal.

According to Sloman, an emotional state normally involves having at least one fairly strong motive. He states that the only significant form of free will is that which involves taking decisions on the basis of ones own motives and beliefs. Satisfaction or violation of this motive then produces the emotion. This can then generate several sorts of cases, depending on whether the motive is concerned with something strongly desired, or something strongly disliked, whether the desire is thought to be satisfied or violated, or whether there is uncertainty about which is the case.

Consequently, motivations are very important building blocks in the creation of believable emotional behaviour. First when motivations are present can a character make an informed decision about what to do because now he knows what kinds of things are important to him. This means that a combination of personality and self-motivation can function as the foundation for an emotion model; emotional states are then the result of evaluations (appraisal) of events and outcomes of actions and goals, with respect to a character's motivations.

2.2.3 Conclusion

In the previous sections we have tried to identify what makes a story interesting. We have seen the importance of a bond between reader and character and that such bonds emerge through believable behaviour of story characters. In turn, for agents to behave believably, they need to have the ability to choose one course of action over another based on their motivations. When agents can reason about the importance of events, they can in turn determine what kind of emotional response is suitable (and believable) in a specific situation. When these motivations are apparent to the reader, and when the characters behave according to their motivations, empathy and identification become possible.

Although it might be stating the obvious, it should be noted that in addition

to characters that behave believably, in order to create interesting stories the story's subject of content should also be interesting to read about. Characters should have interesting personalities and functional roles in the story. Furthermore, they should take on interesting goals to attain or encounter conflicts to solve. For instance a personal conflict, which Szilas [44] considers to be the core of dramatic narrative. All these ingredients contribute to an interesting and coherent story and are mainly a matter of authoring.

Looking at the current state of the VST, it can therefore be concluded that the characters should be provided with a personality and some sort of mechanism of self-motivation (conation) to form motivational goal management upon which we can later base emotional reasoning. The author will be responsible for creating interesting story content.

3 Motivational Goal Management

In any situation during the VST's story generation, characters will have certain goals available from which they can choose. To realize believable behaviour, a character should pick a goal that is suitable for it in the current situation. For this, as we have seen in section 2.2.2, the current characters of the VST should be provided with motivations on which they can base their behaviour. Two characters with different motivations will then likely adopt different goals. When they are planning to achieve the same goal, characters may create different plans even though their external environment is the same. The differences between the plans arise as a result of different motivations.

The following sections are about how motivations can be represented and eventually integrated into the behaviour of the virtual characters of the Virtual Storyteller. We will explore possible approaches of modeling motivation by looking at related work in this area. By means of a domain analysis we hope to learn what motivations are used in pirate stories and in which way. This will eventually result in an implementation approach which is presented at the end of this chapter.

3.1 Modeling Motivations

Now how exactly should we model motivation? Before we start examining related work, we have to make clear what we mean by motivation in the context of this research. In this research I aim to develop goal management for the characters in the VST that is based on their motivations. As we will see, a lot of different terms are being used for the same subject, but desires, drives, urges and motives all seem to point to either personality variables like greed, boldness and pride or interests like well-being and wealth. Throughout this thesis, I will use the term *interest* for characteristics that can motivate behaviour, but clearly are not part of a character's personality (like 'martial arts' or 'wealth' for example). Interests stimulate a character to behave in a corresponding manner and take on goals that are in line with these interests. Interests drive characters to undertake certain actions to try to eventually contribute to these interests while personality traits are more like behaviour guidelines. A character is generally not actively pursuing loyal behaviour (*'let's go and do loyal things all day!'*) but wants his decisions to be in line with his loyal personality. Personality influences the way in which interests are pursued (*'doing this would conflict with my loyal attitude'*). The term *motivation* will be used as umbrella for both personality traits and interests (see figure 9).

3.1.1 Related Work

In this section we will examine other work in the area of automated story generation that incorporates motivation to help us decide how to model motivation for the VST. As a first lead, Crawford, in chapter 11 of his book on interactive storytelling [10, p.182], stresses the use of artistic simplification. According

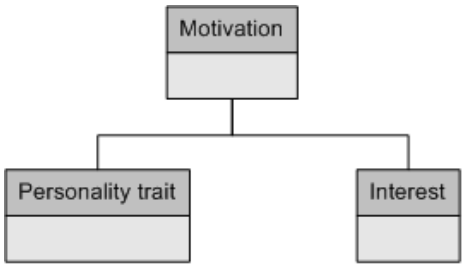


Figure 9: The two types of motivation distinguished in this thesis.

to him there is no need to exactly duplicate reality; mostly because realism is boring: "*Real people are not as highlighted in their personalities as actors in drama. They make prudent decisions, while characters in stories make bold ones*". Crawford proposes to create a trait-based personality model for story characters. His models contain intrinsic personality variables like greed, lust and pride which are quantified to represent the measure of strength of each trait.

In psychology, there are many different theories that account for personality, but trait theories in particular are popular. Riedl summarizes this perspective as follows: *"Trait theories of personality assume that individuals differ along certain dimensions that correspond to traits. How much individuals differ is a matter of measuring the amount or quantity of each dimension"* [34, p.99]. A well-known and widely-used trait theory is the Five Factor Model (FFM) by Costa and McCrae [9] which uses five super traits (and their counterparts):

1. Openness to experience (vs. Closedness to experience)
2. Conscientious (vs. Lack of conscientiousness)
3. Extraversion (vs. Introversion)
4. Agreeableness (vs. Disagreeableness)
5. Neuroticism (vs. Emotional stability)

Inspired by trait-based personality psychology and earlier automated story generation systems that use traits, like The Virtual Theater Project [18] and Universe [22], Riedl himself developed a trait-based model of personality for story characters for his narrative generation system Fabulist. In his model, Riedl uses traits as binary descriptors instead of quantified traits. This means that his characters either have a trait or they do not.

In contrast to intrinsic personality traits, Ortony, Clore and Collins's OCC model [1] makes use of a special type of goal that represents a character's interests. The OCC model uses three types of goals among which are active-pursuit goals (A-goals) and interest goals (I-goals)[6]. A-goals are viewed as 'things that one wants to get done'. These are usually short-term goals for which a specific plan can be made. A-goals are currently the only goals used by the VST. I-goals

[6]A third goal type in the OCC model is replenishment goals (R-goals). These goals are not abandoned when achieved and include biological needs and cyclic goals like filling ones tank with gasoline.

represent 'things one wants to see happen' and are directly related to character's desires and motivations. I-goals are long-lasting and cannot be planned for directly. Usually A-goals are adopted by a character to facilitate an I-goal. Take for example one's own well-being as I-goal. This is a goal that is not finally attainable, one can only try one's best to facilitate it, for instance by adopting the A-goal of going to the dentist when one has a toothache. Another illustrative example of the difference between A-goals and I-goals considers the following goals: `BecomeUniversityStudent` (A-goal) and `StayUniversityStudent` (I-goal).

The OCC model suggests a hierarchy of goals, where the interest goal is parent goal to active-pursuit goals that facilitate it. The I-storytelling application of of Cavazza, Charles, and Mead [6][7] makes use of goal hierarchies implemented in hierarchical task networks (HTNs). The I-storytelling system generates sitcom scenarios based on the well-known TV-series *Friends*. Before each simulation, some characters are assigned a pre-authored HTN which determines their behaviour. The parent goal of their HTN motivates a number of subgoals (see figure 10). These subgoals can in turn also have several subgoals that function as alternative ways to attain their parent goal (see figure 11). At the lowest level of a HTN are actions that realize their parent goal through interaction with the virtual story world. When all direct children of the parent goal of the HTN are attained, the character behaviour for the specific scenario is completed.

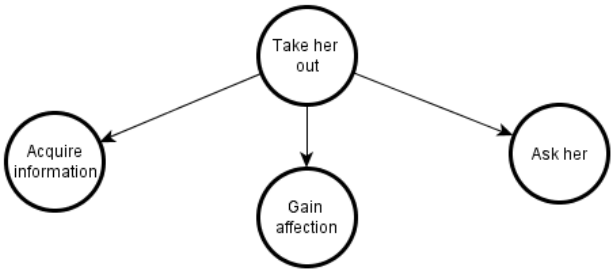


Figure 10: Parent goal and subgoals of an HTN taken from the I-storytelling application

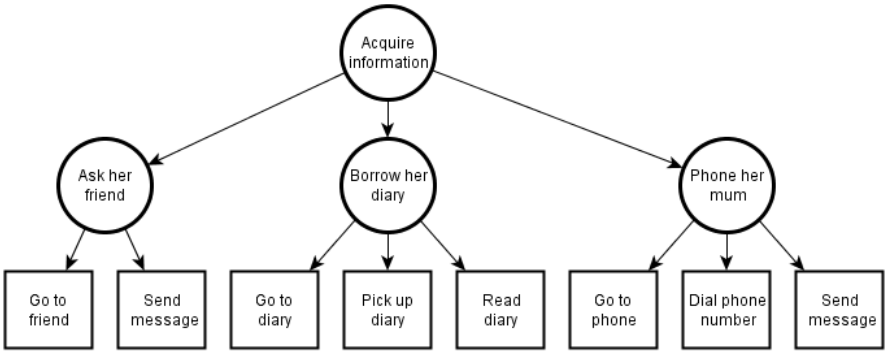


Figure 11: Subgoal with subgoals and actions of the same HTN

In figure 10 you see an example HTN of the character Ross that wants to take Rachel out (parent goal). In order to attain this goal he first has to complete three subgoals: acquiring information about her, gaining affection and eventually asking her out. These subgoals (and their respective actions) are selected in a left to right order. When the rightmost subgoal *ask her* is completed successfully, this completes the character's behaviour for this scenario. More recent work of Pizzi and Cavazza has resulted in the EmoEmma application where HTNs are replaced by heuristic search planning(HSP) [28].

With THESPIAN [37][36] the author assigns to the characters a number of interest goals with associated initial goal importance to influence character behaviour. During simulation a character uses its goal states to determine his next action. To illustrate this, when characters have goals such as *safety* and *being likable* these goals are assigned an initial weight, say 0.25 and a maximum weight, say 1.0. Goal states represent an agents progress in achieving a particular goal, and the agents try to maximize this achievement. The characters in THESPIAN make decisions based on their beliefs on the possible effects of such decisions. A character evaluates the overall effect with respect to its goals and then chooses the action that has the highest expected value for these goals.

Characters in FearNot! (as described in section 1.2) generate emotion through relating their goals to their current environment. FearNot! uses both OCC's active-pursuit goals and interest goals, without the use of a goal hierarchy. One interest goal that plays an important role in FearNot!'s bullying scenarios is `AvoidGettingHurt`. As an interest goal, this goal does not have any preconditions, success or failure conditions since it does not become active or inactive. However, the interest goal possesses one extra parameter; a protection constraint [3] and the FearNot! planner will try to prevent actions that threaten such conditions. As a result, a frightful character is not likely to stand up to the bully because considering this action results in a threat to its interest goal, which results in the generation fear. The intensity of emotions in FearNot! decays from the moment it is generated. The decay factor is different for different emotions, and can also be differently set for different characters.

It can be disputed that all of a character's motivations can be modeled as goals. For example, Luck and d'Inverno, when considering the motivation 'greed', state: "*This is not a goal in the classical artificial intelligence sense since it does not specify a state of affairs to be achieved, nor is it describable in terms of the environment. However, it may, if other motivations permit, give rise to the generation of a goal to rob a bank*" [24, p.1]. The distinction between the motivation of greed and the goal of robbing a bank is clear, with the former providing a reason to do the latter, and the latter specifying what must be done. Luck proposes to specify motivations like curiosity, safety, fear, hunger, etcetera as traits. In agent design, these motivations can then be associated with goals. Motivations can also vary over time according to the internal state of the agent. For example, if the agent spends a long time without food, then the importance of the hunger motivation will increase. When the agent eats, its importance will decrease [8].

This closely resembles part of the PSI theory developed by Dietrich Dörner [12]). PSI is a psychologically-founded theory that incorporates all basic components of human action regulation such as perception, motivation, cognition,

memory, learning and emotions in one model of the human psyche [30]. With the PSI theory, an agent possesses a number of innate desires (needs) that form its motivations. These needs include: existence-preserving needs; species preserving needs; need for affiliation; need for certainty and need for competence. PSI agents base their choice of goals on their set of needs and their respective strengths. A deviation from a set point constitutes the strength of each need. The strength of an agent's needs can increase through activities of the agent and also just by the passing of time. They can decrease through actions that satisfy the needs. Through so-called *intentions* the PSI theory assigns importance to goals. Intentions are calculated from the strength of needs and additional information about goals (such as urgency) and their success probability. Success probability is determined by the agents memory which can recall similar situations that have been encountered in the past.

The use of needs following the PSI theory is implemented in ORIENT (Overcoming Refugee Integration with Empathic Novel Technology) [30]. This application builds on the FearNot! Affective Mind Architecture (FAtiMA). Where in FearNot! emotion generation was based on scripted rules and interest goals to conduct believable behaviour, with ORIENT FAtiMA is extended with PSI features that make internal processes self-regulatory and driven by needs. The inclusion of needs required a change to FAtiMA's existing goal structure. In the new architecture, each goal will contain information about expected contributions of the goal to an agent's needs. It is concluded that PSI permits more flexibility in the characters' behaviour that FAtiMA lacks. However, this, in turn, results in having less control over the characters' behaviour.

3.1.2 Discussion

From what we have seen so far, motivation (which includes personality and interests, as stated in section 3.1) is either modeled with traits or in the form of a special type of goal; OCC's interest goals. Although these trends clearly differ from each other on a conceptual level, they are not mutually exclusive and sometimes it is hard to distinguish both approaches. With THESPIAN for example, a character is assigned goals like *safety* which in turn is assigned importance. The character will then try to behave in line with this goal, trying to maximize its value. This is not much different from, say a PSI agent with *safety* as only need. This agent too will behave in such a way that safety is maximized. Interest goals in FearNot! function as protection constraints and represent conditions that should be met or avoided. They are not actually used as goals, but influence the planning for active-pursuit goals. Riedl's traits in his personality model for Fabulist do exactly the same to realize consistent character behaviour.

A case can be made that we are not faced with a real choice here. Both traits and interest goals are suitable constructs to motivate character behaviour and the choice for one over the other depends on what type of behaviour we want to realize. For example, when we want a character to keep someone a prisoner it is very hard to find and quantify traits that will realize this. This situation seems much more suitable for a condition that explicitly states the desired behaviour.

Authoring an HTN before the simulation, as with the I-storytelling application, ensures coherent believable behaviour, since all action is motivated by the parent goal. This approach however severely limits (or even completely takes away) character autonomy. With the ORIENT application, motivation based on PSI traits promotes character autonomy through self regulatory processes but results in less control of character behaviour. Whether having less control is a bad thing depends a lot on the purpose of the application you are working with. Since FearNot!, THESPIAN and ORIENT all have educative purposes, control is needed to ensure the educative goals are attained. A combination of traits and conditions therefore seems ideal. When using traits to promote character autonomy, interest goals can be used as conditions to regulate this character autonomy. As stated in section 1.2, it is believed that character-centric systems tend to result in stories with strong character-believability but weak plot coherence. Regulation of autonomous behaviour is then likely needed to direct the characters into making a good plot.

3.1.3 Conclusion

Having read the above, and since the goal of this research is to make the VST characters more interesting, it seems plausible to start with providing VST characters with trait-based motivation to influence their choice of goals. Following the PSI theory, these traits can be assigned before the start of the simulation. Because PSI makes use of general needs that seem too general for a storytelling domain, we need to specify traits ourselves. These traits will be used to model both personality traits of characters as well as their interests. A character's personality traits and interests will then be associated with the VST's goals in order to connect motivation and behaviour.

From the work of Luck and Coddington as well as from the PSI theory, we can conclude that motivations can and should change over time. While personality is constant (at least on the short term), satisfying interests like hunger decreases their importance temporarily. Neglecting interests over time should result in the increase of importance until satisfaction, which in turn will decrease importance. Like the PSI theory, we should therefore develop a mechanism to measure satisfaction of interests (but not of personality traits which are, as mentioned earlier, constant in strength).

3.2 Motivation In The Pirate Domain

As concluded in the previous section, goals, personality traits and interests (and eventually emotion) combined constitute self-motivation for characters and influences their choice of action. But what qualifies as personality trait or interest? Since the VST is currently focusing on pirate stories it would be good to know whether there are specific traits associated with pirates that have to be present in pirate stories. To get an idea of how we are to use personality traits and interests, it is time to take a closer look at the context in which this self-motivation will work: the pirate domain.

In the following sections we will take a closer look at pirate story content to try and give us a better understanding about what is characteristic to pirate stories and, more important in this context, to pirate behaviour. Consequently, this will help identifying pirate interests and personality traits of which some may be incorporated directly in the implementation of motivational goal management. In any case, the results of this domain analysis can be used as a general direction to look in when modeling personality and self-motivation for the VST's characters and will provide inspiration for the creation of scenarios to use with the implementation.

3.2.1 Domain Analysis Setup

For the pirate domain analysis I have collected a number of comic books about a pirate known as Redbeard. 'Redbeard' is a series of Belgian comic books, originally published in French (but, luckily, translated to Dutch), created by writer Jean-Michel Charlier and artist Victor Hubinon [47]. The series was very popular in France, Belgium and The Netherlands, but has not yet been published in English.

I have chosen comic books because comics usually are stories that make use of cliché behaviour, stereotype characters and clear motivations and expressions for their plots, which according to Crawford (as mentioned in the previous section) is exactly what we need. Because I am looking for typical pirate characteristics and recognizable elements of pirate stories and since enhancing the VST's characters should facilitate the creation of believable characters and not that of rational behaviour, these Redbeard comic books seem a good starting point.

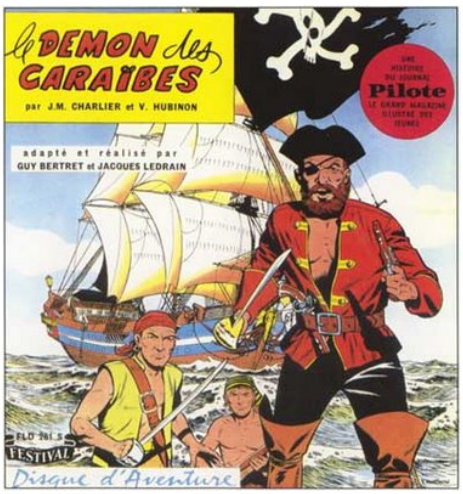


Figure 12: Redbeard (barbe-rouge), 'demon of the Caribbean'

As stated above, the results of my analysis of the pirate domain are the combined results of the findings of the story analysis performed on several Redbeard comics. A typical story analysis incorporates story elements such as composition, time, space (setting), narrative perspective, characters, motives, theme,

motto, etc. Work during the analyses mainly consists of providing a summary with the main events and storyline, identifying personality and role of the main characters and looking more closely at their behaviour, e.g. looking at motivation as well as (emotional) reaction to actions and events in the story world.

While the focus during analyzing the stories is on motivation and personality, all information that could prove useful for the current state of the VST will be collected. This includes:

1. Characteristic pirate themes, settings and (recurring parts of) the plot line
2. Typical objects associated with pirates which are relevant in pirate stories
3. A description of the characters and their personality inside the story
4. Interests associated with pirates; why are they doing what they do?
5. Emotions associated with pirates and, when present, coping behaviour corresponding to these emotions

The first two categories of information are useful for the VST in general. The results extracted from the Redbeard stories add story elements to the available domain content to generate pirate stories from. Adding these to a story domain would allow for a wider variety of stories generated by the VST. The other categories point more directly toward a character's behaviour: items 3 and 4 define the characters and hopefully explain what is necessary for them to behave like they do. These items relate to motivation (personality traits and interests) and goal management, while item 5 relates to the emotional states and associated behaviour of the pirate characters.

3.2.2 Domain Analysis Results

Below (tables 1, 2 and 3), the results extracted from the story analyses are presented following the aforementioned categories. The results are gathered from six analyses of five different episodes of Redbeard during which we have looked at eight different characters. Three people performed the analysis of one or more comics individually. To put the results into perspective: the terms encountered in the tables below are not necessarily literally extracted from the story text, but are the result of the interpretation of the story analyst. The original analyses can be found in appendix A and the original extracted results are in appendix B (both in Dutch).

Since the focus of this research lies on motivation and character behaviour, I will not present results from the first two categories (referring to story setting and story content) here. For these results I refer to appendix B. Because motivation is a foundation for emotion, the results concerning emotion are also presented here so that they might be taken into account during the work on motivational goal management.

brave	stubborn	faithful
determined	cowardly	non-negotiable
mean	slick	haughty
merciless	loyal	cautious/alert
violent	ruthless	friendly
unscrupulous	noble	desperate
greedy	bold/fearless	suspicious
impulsive	pessimistic	cruel
upright	opportunistic	sly
intelligent		

Table 1: Personality traits identified in the reviewed Redbeard stories

affection (for someone)	information gathering
weariness	love (for someone or something)
owing someone something	loyalty
education	succession
a sworn oath	survival/health
repaying a debt	patriotism
honor	duty
family	pride
hate (against society)	ambition
hate (for someone)	trust
greed/wealth	freedom
revenge	

Table 2: Interests identified in the reviewed Redbeard stories

3.2.3 Discussion

Before we discuss the results of the domain analysis, I want to stress that the found results are not necessarily the ultimate pirate characteristics that have to be implemented. Also, while the motivations are derived from the pirate domain, most of them also seem general enough to be suitable for other story domains. Some content will eventually prove usable, and some will not. Because of the informal approach to the analysis, it is also possible that some content is not found during the analyses, but can end up in the implementation anyway. In any case the domain analyses results show some motivations that can be used

abhorrence	relief	surprise
fear	pride	confidence
happiness	doubt	despair
irritation	contempt	distrust
frustration	astonishment	anger (regarding the circumstances)
hate	sadness	anger (regarding someone)
hope	humiliation	revenge
incapacity	indignation	self-satisfaction

Table 3: Emotion words identified the reviewed Redbeard stories

and give examples of how they can be used. This can in turn inspire us to think of other motivations to use. In short, the identified results are not supposed to be binding, concise nor complete, they are just there to help us get a feeling for how pirates 'work'.

Content in general
Looking at the found content, it can be concluded that the domain analysis has provided us with a lot of potentially usable information. We now have gotten a general idea of which personality traits and interests we could use for the character's decision-making (concerning goal management). This provides a nice starting point for initial implementation ideas. Also, a set of emotion words has been identified during the reviewing of Redbeard stories. While these words alone are still very general and do not immediately dictate when to use them, the collection itself might prove a useful specification of the numerous existing emotion words. Also, should motivational goal-management eventually allow for emotion in characters, then the set of encountered emotion words gives us an idea of what emotional states the characters of the VST eventually can have.

Difficulties using specific terms
A critical examination of the collected data leads to some less positive observations. First, it is not always clear where the meaning of one item ends, and the next begins. In other words, some terms suffer from some ambiguity. For example, take *loyal* and *faithful*. While their individual definitions differ, their meaning hugely depends on the detailed context in which they are used. It is possible to think of situations where these two terms are practically synonymous, while in other situations the use of one above the other would be preferred. I feel it will be hard for an author to provide characters with these kinds of traits while not knowing in advance what their specific contexts of use will be. On the other hand it is also one of the charms of automatic story generation to not exactly know what eventually will happen.

Another thing that stands out is that some items seem to be each others opposite to some extent. For example, look at *bold* and *frightful*. While, opposed to the previous example of ambiguity, bold and frightful have clearly different meanings, for modeling purposes it can be confusing when questions like the following arise: Is a character with a very low intrinsic value for boldness frightful? Does low frightfulness imply boldness? In other words, when these terms are used, are they connected as a pair *frightful/bold* where high means bold and low means frightful? Or are they independent of each other and can they exist next to each other in a character?

Because of these possible difficulties with the use of interests and/or personality traits, I want to stress again that the terms used for motivations in the following outline of the implementation of motivational goal management and throughout this whole thesis are in no way meant to be final, complete or binding. There are no rules for this, what you see are just examples of how these motivations *can* be used. Since the implementation of motivational goal management will be domain independent, this means that the author of any future story domain is free to use the terms he wants with whatever meaning he has in mind.

Findings that are not motivations
While performing the domain analysis, we also encountered things that were

happening that no character explicitly wanted, but that still played an important role in the story. *Explosions* for example are very important in pirate stories with the characteristic battles at sea with cannons roaring and barrels of gunpowder and ships exploding. This normally is not something pirates explicitly want to happen. The reason for a sea-battle mostly involves some disposition towards a rival ship. For *explosions* to be a character's interest you would need to have a case of pirate pyromania, which of course is perfectly possible, but might not be a general solution to these kinds of story needs.

Things like explosions in pirate stories are welcome side effects of a character's actions. While the characters themselves only care about their goal, the story itself (and the author with it) cares about the interesting way in which goals are achieved. Phenomena like explosions can be seen as interests of the story (or author) itself. Another way of looking at it would be from the perspective of the reader. The reader might like a specific genre because things like explosions are bound to happen. Consequently, it is important to keep in mind what the reader expects when starting to read a story and give the characters the means to meet the reader's expectations. While characters with motivations and emotional behaviour should be able to do a lot of the work, we may need to help them a little to ensure the result will be interesting.

Concluding the *explosions*-example: things like *explosions* are goals that exist on story level and are therefore usually not part of motivated character behaviour. This illustrates the dilemma that exists between simulating autonomous character behaviour and some measure of control to steer towards an interesting story. This dilemma was mentioned earlier in sections 1.2 and 3.1 as critique on purely character-centric story generation applications. A possible solution that adheres to character-centric philosophy would be to divide the character agent architecture into an 'in character'(IC) and an 'out of character'(OOC) part. The OOC part can then be viewed as an actor that takes on a role (IC part) in the story. More can be read about this in [20] and [43].

Prepared for ambiguity and other possible authoring problems, the domain analysis results have provided us with inspiration for use of motivation in the pirate domain. With the obtained information about pirate personality traits and interests we now can start with implementing motivational goal management in the VST. This is exactly what the next section is about.

3.3 Implementation Approach

The following sections contain the implementation approach of motivational goal management which is loosely based on the personality traits and interests identified during the domain analysis in the previous sections (section 3.2.2 to be exact). First we will see how motivations are modeled, after which they are integrated in the goal management of the Virtual Storyteller. Additionally, a new fabula-element will be introduced that facilitates the incorporation of the new goal management in the actual stories the VST produces.

As before, in the following description of the implementation, when the term 'motivation' is used this includes both personality traits and interests.

3.3.1 Implementing Motivations

Below, the important aspects of the implementation of motivational goal management in the Virtual Storyteller are being discussed. The next section will show how these aspects work together in a goal management algorithm.

Personality and Interests
Each personality trait has an associated name and strength, as can be seen in figure 13. The idea is that personality traits are intrinsic and are not very likely to change during the relatively short stories produced by the VST. The strength of a personality trait corresponds with how important this characteristic is during decisions in goal management. When encountering a decision, a character can base its choice on its weighted personality traits. Consequently, this also means that stronger personality traits are more likely to emerge during the story as recognizable attributes of characters.

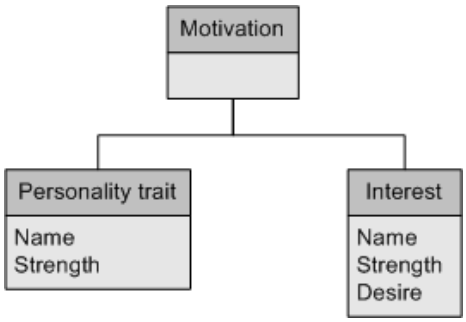


Figure 13: Motivation properties in motivational goal management in of the VST

Like personality traits, interests have intrinsic strengths; when characters like something, they will always have some affinity with those things but not necessarily always exactly the same amount of affinity. In contrast with personality, interests can have temporarily less importance for a character, depending on its internal state. For example, a character that likes to eat pie very much will likely choose a goal to get and eat pie. When this goal is achieved, the character might still want to eat pie, but likely a little less than the first time. One can imagine that after a number of pies, a character might find it a better idea to choose some other course of action than eating pie yet again. Consequently, interests should have a desire value that indicates how important this interest is *at the current moment*. When an interest has a high strength, but a very low desire, this interest will not be considered a strong motivation and is therefore less likely to be decisive during goal management decisions.

Strength and Ranges
At the moment, there is no defined value range to which the strengths of interests and personality traits must adhere. It does not really matter whether you assign `100` or `1,000,000` as value to some motivations, it's the relative differences that matter. It could be argued that when using `0` as strength for some interest, it is better to not use this interest at all, since it won't have any influence on a character's decision making. However, theoretically an author could have

aesthetic purposes for adding some characteristic to a character without the need for it to interfere in the unraveling of the story. For example, during the introduction of a story, the reader could be given some information about characters that adds to their conception of these characters during the whole story, while this information never actually influences decisions.

Desire
The desire value of interests is modeled as a fraction; initially a number between `0` and `1` (implemented as a `float`), but possibly bigger. The default value is `1`, but a different value can be assigned before the start of the simulation. Initially, strength and desire render a certain importance-value for an interest. When this interest is used as a motivation during a decision, upon completion of the associated goal the desire for this interest is considered satisfied. Consequently the interest's desire value is reset to zero to ensure that this interest will play a less important role during decisions in the near future. This is illustrated by figure 14.

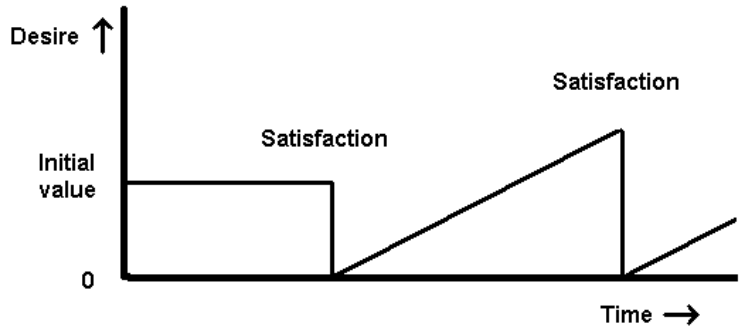


Figure 14: A possible graph of the desire value of an interest during simulation

Over time, the desire will increase again. At the moment, it is increased with `0.02` per round that has passed since the desire has been reset. There is no good reason to use this exact number, but the thought behind its size is that desire should not regrow too fast and therefore advocates a small number. For example, if desire would only take two rounds to grow back it's initial value, the effect of satisfaction would be lost.

It might be important to note that the regrowth of the desire is not limited to the initial or default value; it can grow beyond those values (again see figure 14). The idea behind this is that constantly neglecting a particular interest should increase the urge to satisfy it. Currently, only the desire of satisfied interests is reset and updated, but it would be nice to have desire of interests that are neglected increased as well.

Importance Calculations
During goal management decisions, two different types of importance values are calculated: interest importance and goal importance. Interest importance follows from the strength and the current desire of the particular interest and is calculated as follows:

$$Interest\ importance = strength * desire$$

The importance of goals depends on the strengths of personality traits combined with the importance of the interests; i.e., all motivations that are associated with this goal. Motivations can relate to goals in either a positive way or a negative way, for example a dangerous goal can be good for one's wealth, but hazardous with respect to one's well-being. Since both wealth and well-being could be interests of a character, the way in which they relate to goals should be distinguished and used accordingly in the decision process.

This results in the following formula for calculating goal importance, where the summation of positive motivations stands for the sum of strengths of the positively associated personality traits added to the sum of the importances of the positively associated interests. The summation of negative motivations can be explained analogously.

$$Goal\ importance = \sum(positive\ motivations) - \sum(negative\ motivations)$$

PSI revisited
Calculating goal importance from motivations closely resembles the PSI theory (as mentioned in section 3.1.1). In the PSI theory, the calculation is as follows:

$$Intention = \sum(needs * goal) * successprobability * urgency$$

The term 'Intention' in PSI is analogous to goal importance as is used here. The first term of the calculation resembles exactly what we do, except for the fact that PSI does not use negative motivations (with PSI, goals always facilitate associated needs). The importance of goals is still calculated from all relevant motivations. Additionally, PSI incorporates the success probability of the goal, which is taken from agent memory. The VST does not use agent memory, so this term cannot be used here. Lastly, PSI multiplies the goal importance with the urgency of the goal, which means that urgency adds to importance. This is a big difference with what we do here because, as can also be read in the following section, in the VST urgency and goal importance are two completely different things. Urgency takes precedence over importance and does not add to it.

Authoring
From the author's perspective a few things have to be done in order to realize working motivational goal management. First of all, the characters of the story should be provided with the preferred personality traits and interests and for each motivation the intrinsic strength should be assigned (with interests an initial desire can also be assigned). This knowledge is added to the knowledge base through the setting; the description of the initial state of the story world. In the setting the characters are given individuals of motivation classes that are represented in the domain ontology. Finally, goals in the goal base will have to be associated with motivations. This is done by filling in the lists for positive and negative motivations in the goal schema.

3.3.2 Goal Management Algorithm

During goal management a character decides which goal to select as its active goal. The adoption of goals usually takes place in two general situations: at the start of the story and after achieving a goal (also see section 1.3.2). In other words, only when a character currently has no active goal it should think about what to do next. This prevents the character from changing goals all the time and never completing a plan for achieving a goal.

For example, it could be the case that after taking on the current most important goal, execution of the first action of the plan for that goal makes adoption of another goal possible. This other goal could be more important than the active goal and would therefore be preferred by the character over the currently active goal. The storyline will usually not benefit from schizophrenic characters that abruptly switch goals all the time and never finish what they start [35].

However, never allowing a character to change goals would be oversimplification. Most important here is that the goal switch is comprehensible for readers of the story. Some scenarios could be thought of in which a change of goals would be very suitable and also beneficial for the story. Looking at reality, I think you would not have much trouble finding someone who would happily quit his job to earn 10 times his current salary somewhere else. Ideally a character should change goals in some situations, like when the difference between the two goal importances meets some requirement. However, at the moment no such requirement is implemented which means goal-switching will not take place in the current implementation.

Active goals can however be *interrupted* by goals that are more urgent. For example, when a pirate is painting his cabin when a fellow pirate walks by greeting him, it would be nice to interrupt the painting and take on the currently more urgent goal of greeting back. Urgency was already present in the goal management of the VST before this research started. It is possible to assign an urgency value to a goal and when this goal is adopted and has higher urgency than the current active goal, the active goal will be interrupted. In contrast with desire values, urgency values do not change during a simulation.

The following flowcharts show how the goal management algorithms worked before this research started (figure 15) and how it works now (figure 16). Both algorithms are presented from from a character's point of view.

The new goal management algorithm, after the usual checks for presence of an active goal and eventual more urgent goals, continues with examining a character's interests. When a character has interests it looks at the character's adopted goals and checks whether there are some goals associated with interests the character has. If so, it chooses the goal with the strongest combination of interests and personality traits, i.e., it calculates the goal importance for each goal a character has adopted in the current situation and identifies the one(s) (there can be multiple goals with the same importance) with the highest importance. These are then added to the goal options of the character. If there is only one option, this becomes the active goal. When a character has multiple options, which means that there are several goals that have the same highest importance, the character will choose randomly between them.

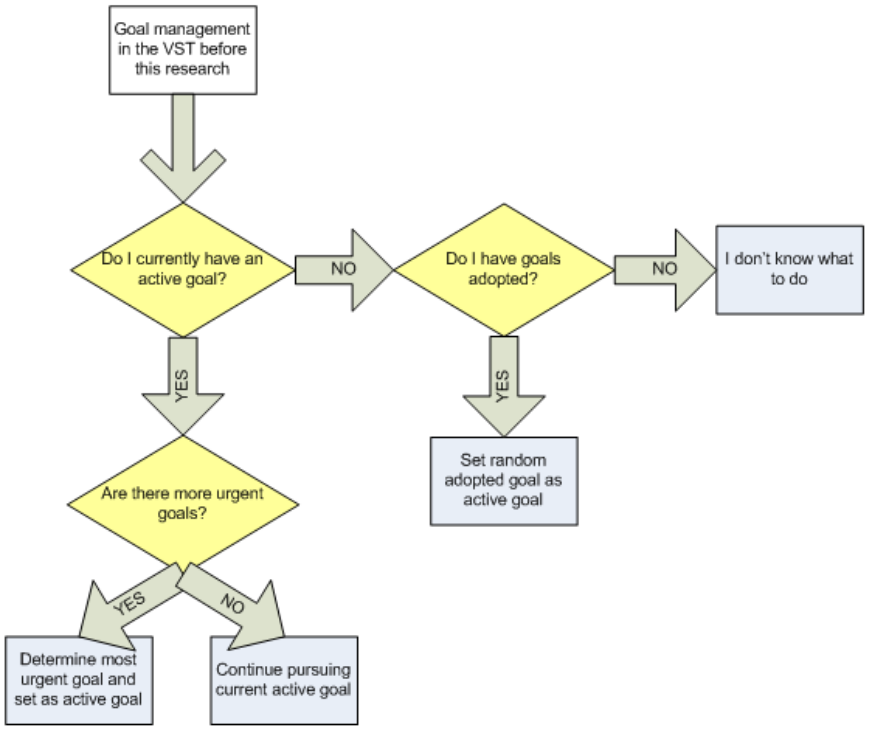


Figure 15: The goal management algorithm of the VST before this research

With respect to this last situation a slight alteration of the algorithm can be considered, namely that with several goal options the goal that has the strongest interest or personality trait associated can be chosen. In the case of two goals with equal importance where one goal has three motivations associated and the other goal just one, the goal with one, by far the strongest, motivation will be chosen. This alteration enables the characters to prioritize their most important motivation. This will probably result in better communication of a character's important traits to the reader because these traits will have a more clear effect on behaviour.

Whenever a chosen goal is attained, the desire values of the associated interests are reset to zero. This value will then again increase over time (0.02 per round), based on the time that has passed since the completion of the associated goal (time in the VST is kept in rounds). Note that the desire of an interest that is appointed as a negative motivation will not be reset, since taking on a goal *even though it is bad for that interest* cannot be considered fulfilling one's desire for that interest (example: 'Although this object is very expensive, I will buy it anyway. Now my desire to possess money will be decreased').

To illustrate the internal workings of the goal management algorithm a sequence diagram has been developed. The Virtual Storyteller's knowledge resides at the Prolog side and the goal management algorithm is at the Java side of the application (see section 1.3.1 for more information about this). In order to calculate

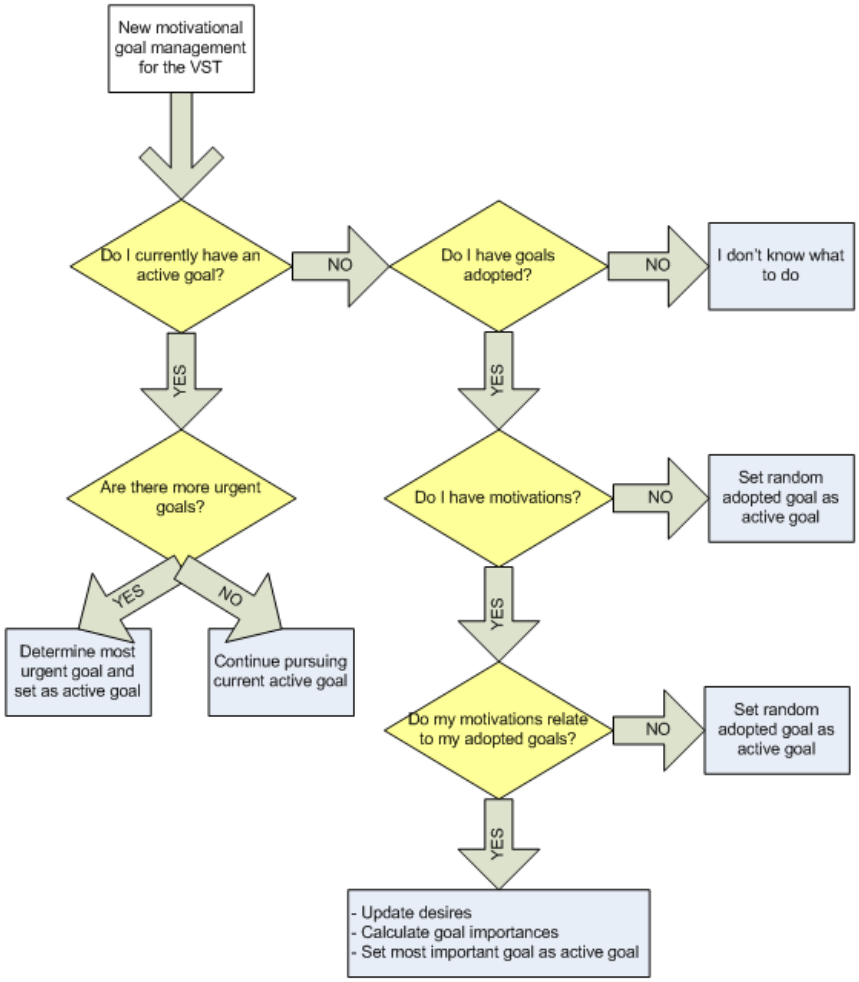


Figure 16: The new motivational goal management algorithm of the VST

strength of motivations and goal importance this data has to be communicated from one side to the other. The sequence diagram in appendix C shows the interaction between Java and Prolog during motivational goal management and which methods and predicates are involved.

To illustrate the authoring process involved with motivational goal management, the next section will present an example a scenario from the pirate domain.

3.3.3 Example Scenario

Below, an example scenario is presented which illustrates the motivational goal management algorithm that was presented in the previous section. This scenario is a shortened version of a scenario that can be found in the Evaluation chapter (section 4.1.3). Here, the scenario will illustrate how character motivations should be authored and how goals should be associated with these motivations

in order to enable the motivational goal management algorithm to work as intended. More information about the simulation that results from this authored scenario and variations of this scenario and their simulation results can be found in chapter 4.

Scenario setting
A pirate and a captain are together on a ship. Because the ship is being followed by a dangerous enemy ship, the ship needs to sail faster to escape its pursuers. This can be achieved by losing ballast and hence the captain orders the pirate to throw the heavy treasure overboard. It's the pirate's move.

Authoring
First we will create the pirate character. As a starting point, we will take a pirate that is obedient and will be likely to do what his captain tells him to do. A corresponding personality trait could be `loyal`. Next he is also more than average attached to his life, which renders him the interest of `self-preservation`. Now both should be given a strength. The character's definition would now contain the following information:

```
:pirate
  swc:hasPersonalityTrait :loyal_1;
  swc:hasInterest         :self_preservation_1;

:loyal_1
  a :Loyal;
  swc:hasStrength 70;
  .
:self_preservation_1
  a :Self_preservation;
  swc:hasStrength 70;
  .
```

Assuming we have already authored enough goals for the pirate to choose from, we need to tag these options with personality traits and interests that are suitable in this scenario.

Looking at the order of the captain ('throw treasure overboard') we have two obvious responses: do it or do not do it. The latter response is unlikely for our character, because we have just defined him both loyal and self-preservative. Not dumping the treasure would be considered mutiny and would probably also lead to being caught up on by the enemy ship.

Looking at our pirate, our attention should mainly go to the obedient response, which could be a goal like `DumpTreasureInChaseAsOrdered`. This goal should be associated with loyalty and self-preservation in a way so that our character would be motivated to choose this goal. This means we have to add these motivations in the corresponding goal schema to the list of positive motivations. This would look like this:

```
  positive_motivations([
    ':loyal_1',
    ':self_preservation_1'
  ]),
```

The disobedient response `DoNotDumpTreasureInChaseAgainstOrder` would in this case have the same associated motivations but with a negative impact on

the importance of the goal, so they are added to the list of negative motivations of the disobedient response.

Motivational goal management in action
We will now follow the outline of the goal management algorithm from the previous section. At the start of the simulation, the pirate does not have an active goal and he can adopt two goals, namely `DumpTreasureInChaseAsOrdered` and `DoNotDumpTreasureInChaseAgainstOrder`. The pirate has two motivations, both of which are associated with both adopted goals which means he can now determine the most important goal of the two. The pirate calculates the importance of both the obedient and disobedient responses, which will add up to `(70+70=)140` and `(-70-70=)-140` respectively. The goal with the highest importance is chosen and the pirate obeys his captain's order. After succesfull completion of this goal, the desire of the pirate's interest of self preservation is reset to zero.

3.3.4 Dramatic Choice

With the new goal management algorithm, the choices VST characters make are now motivated. While the author knows this, the reader might not notice much difference when reading stories with and without motivational goal management. Due to the relatively short stories, the reader has not got much time to make a mental model of the characters including premises about their motivations. Therefore, we want to incorporate part of the decision process that takes place 'behind the scenes' in the actual stories the VST produces. This way the reader is informed about the choice a character faces, their alternatives and why it has chosen a particular alternative. This way the reader receives valuable information about the characters' motivations which hopefully adds to a more enjoyable reading experience.

Situations in which characters are faced with a choice that as a big impact on the story progression were also present in the VST before this research started. However, since the decision process is now a lot more sophisticated than before and now makes use of character motivation, these choices become even more interesting. Compared to earlier goal management there is much more to say about the context of such situations and how characters contemplate their options considering their motivations. Another part of the implementation therefore concerns a new data structure that emerges during decision making: the dramatic choice. A dramatic choice materializes in a situation where a character has a number of options to handle with a certain dramatic situation. Often he has to choose one goal OR another goal, in contrast to situations where a pirate can choose the most important from all available goals, after which he can continue with the second most important and so on. Dramatic choices are interesting because they have certain consequences for the storyline. With a choice for one alternative, the other alternatives often cannot be chosen any more.

An example of a situation where a dramatic choice arises is where a captain issues an order. The pirate has to respond to this in some way. He can execute the order OR he can disobey his captain. Doing both sequentially is out of the

question. This example also illustrates the relationship between dramatic choice and interesting conflicts. For example, when a pirate is normally loyal, but the order goes against some of his other characteristics, he has to decide on what to do. On the one hand he wants to follow the orders of his captain, but on the other hand he has his interests to think about. This results in a personal conflict, something Szilas [44] considers to be the core of dramatic narrative.

Integrating Dramatic Choice in the VST
Capturing such situations in a dramatic choice structure requires work on two parts of the VST. On goal level, we can associate the alternatives (goals that exclude each other) with a dramatic choice by giving them a tag that refers to the specific dramatic choice. The dramatic choice will, just like the motivations, be represented by an individual of the dramatic choice class in the domain ontology. Goal management is changed slightly by declaring that upon completion of a goal that is associated with a dramatic choice, all other adopted goals that are associated with the same dramatic choice should be dropped. This technically realizes the exclusive choice we need.

One could argue that exclusive choice also can be achieved by choosing preconditions and success conditions in such a way that executing one choice conflicts with the preconditions of the other choices. In the case of an order issued by the captain, one could add a precondition that states that the order should not already have been acted upon. Analogously, we then need a success condition that states that the order has been acted upon after one choice for either reaction to the order has been made.

This approach could theoretically work, but in situations with more than just two options it will be a lot more work for the author. The reason why working with conditions currently does not work is the fact that, once adopted, goals are not checked for preconditions anymore. The other options will then still be set as active goal, after which they will either fail because no plan can be made for them, or automatically succeed, because the success conditions were already achieved by the first chosen option.

On fabula level we have to keep track of encountered dramatic choices. To be able to do this, we need a new fabula element representing a dramatic choice. Since the dramatic choice is part of the decision process of a character, it is implemented as a child of the already existing class of fabula elements `InternalElement`(IE). As soon as goals are adopted that are tagged as alternatives belonging to a certain dramatic choice, a dramatic choice fabula element will be created.

Next we need to determine where the dramatic choice element should be placed in the story graph. As the event that enables adoption of the goals associated with the dramatic choice also enables the existence of the dramatic choice, it seems logical to insert it after this event. The first idea was to put it in between the enabling event and the chosen alternative, which would result in a structure illustrated by figure 17 (where the dramatic choice element is represented by the IE box on the right). This seems intuitive, because the graph now intuitively reads as 'this event leads to a dramatic choice, which led to the choice for this alternative'. In the depicted story graph an order leads to three options (among which two instances of one goal). The belief that the order has been given

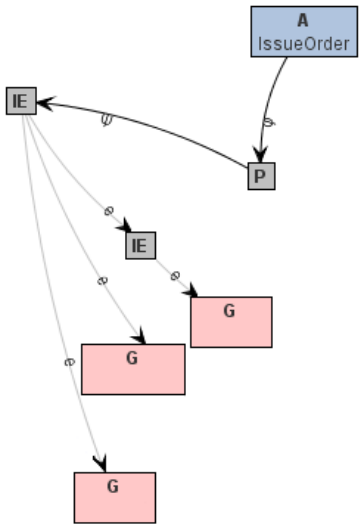


Figure 17: First attempt at integrating dramatic choice in the fabula

enables the adoption of the goals and causes the dramatic choice.

However, as soon as the associated goals with a dramatic choice are enabled, they are connected with the enabling event. After this has been done, the dramatic choice element is created. To insert the dramatic choice element we have to reorganize already logged fabula by putting the dramatic choice between event and alternative. This is technically speaking not a big problem per se, but the logged fabula is immediately sent to all agents involved in the simulation. This in turn means that, by putting the dramatic choice element in between the enabling event and the chosen goal corrupts the fabula knowledge in other areas of the system.

Therefore, we have chosen to insert the dramatic choice element in a way parallel to the enabling event since this does not require changing the existing fabula. Edges will connect the dramatic choice with the event that enabled the adoption of the goals that form the alternatives of the dramatic choice AND with these goals themselves, as is illustrated by figure 18. This has as accessory advantage that, because the dramatic choice now is connected with all alternatives, other parts of the system that can interpret fabula now also can trace all associated goals by traversing the graph.

The dramatic choice element, as do other fabula elements, contains information about the character with which this element is associated. The content field is currently empty, but it is intended to contain the goals associated with the dramatic choice. Alternatively, by traversing the edges of the fabula graph, the goals that are associated with this dramatic choice can be identified. This allows for direct incorporation of dramatic choices in the VST's stories. With some adjustments to the presentation layer of the VST, during narration interesting aspects of the choice can then be told as part of the story. For example, the reader could be presented with the following story fragment:

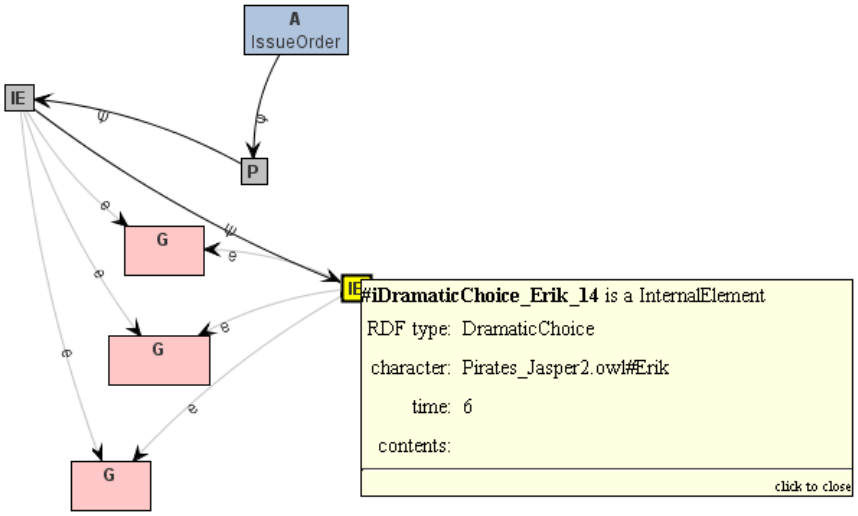


Figure 18: The dramatic choice element in the fabula graph and the information associated with it

"The ship had caught fire. Erik had the option to abandon the ship immediately or to try and extinguish the fire to be able to save the treasure".

When we also manage to involve the motivations that are associated with the options a character has during a dramatic choice, together with their strengths, we could even recognize personal conflicts and get something like the following.:

"The order the captain had given left the pirate with mixed feelings. Should he execute the order in line with his loyal attitude? But surely he could not abandon all this wealth? But would mutiny really be worth it?"

While research and application of the possibilities the dramatic choice offers for the stories of the VST has proven to be beyond the scope of this research, the foundation for its use has been firmly laid.

4 Evaluation

This chapter contains the evaluation of the implementation of motivational goal management for the Virtual Storyteller. As stated in the methodology (section 1.4.1), the focus will be on the working of the implementation and the authoring process. The next section provides a number of implemented scenarios that illustrate how motivational goal management works and how the associated authoring is to be done. The used scenarios are based on the content that was gathered during the domain analysis. After presentation of the scenarios, the implementation, the authoring process and the consequences for the VST's stories are discussed.

4.1 Evaluation Scenarios

In this section a number of scenarios will be presented to illustrate and evaluate the implementation of motivational goal management in the VST. The scenarios have been implemented and provide VST characters with motivations and typical pirate situations (which are loosely based on the domain analysis) and will give them the opportunity to determine their most preferred course of action. Each scenario has a certain story setting in which the characters are placed. This setting will be used to create several simulations of the same scenario with different characters. By altering the characters' personality traits and interests between simulations, we should be able to see the implications these characteristics have regarding the outcome of a simulation of a scenario.

Each scenario description will start with a short introduction that describes the story setting. After that, the authoring process will be illustrated. While the entire story setting is created by the author, the focus is on the authoring steps that are needed to enable motivational goal management to work. This means that I won't describe in detail which actions and goals are authored and which conditions they have in their specific schemas. I will however describe in detail how to author the characters and their traits and how to adjust goal schemas in the existing story setting to make the scenario work. For all motivations used in these scenarios applies that they have a corresponding class in the author's domain ontology.

The URI (Uniform Resource Identifier) of a motivation indicates to which ontology that motivation belongs. For readability purposes, the full URI of a motivation will not be used in the scenarios. Instead a shorter form will be used that makes uses of the default namespace (short declaration of an URI) '`:`' and looks like this:

`:<motivation_individual>`

Where `:` in reality is the URI of the domain ontology that looks like this:

`http://www.owl-ontologies.com/StoryWorldSettings/Domain.owl`

Other namespaces like '`swc:`' refer to more general ontologies of which the VST makes use. The author of a story domain does not have to concern himself with

these.

In addition to explaining how the authoring is done, the characters that have been authored will be shortly discussed. This is to explain the intended meaning of the terms used for the personality traits and interests where necessary and might reveal the intentions of the author for the coming simulation. This will hopefully help illustrate the connection between authoring and the actual simulations.

When the authoring is done, the simulation that resulted from the authored story setting will be described. In addition to a description of what happened in the simulation in story terms there will be a description of what happened in the 'mind' of the characters to explain why they acted as they did. This will be followed by a short discussion about whether the expectations that were created during the authoring process are met by the actual results. Other possible points of interest may also be discussed here.

For each scenario there will be several 'reruns' with different characters, of which the authoring again will be described and the resulting simulation discussed.

4.1.1 Scenario 1A

To start off, let consider a pirate who finds himself on a ship without anything urgent that needs his direct attention. Depending on the pirate's personality and interests he will now choose what to do.

Authoring
Let's define a modest number of goals for the pirate to choose from in this situation:

1. `Sleep`
2. `GetAndDrinkRum`
3. `LookOutForEnemies`
4. `SearchAndKillVermin`

If we want our pirate to be aggressive and to fancy fighting, we will have to add this personality trait and interest to the character's definition and assign strengths to them:

```
:pirate
  swc:hasPersonalityTrait :aggressive_1;
  swc:hasInterest         :fighting_1;

:aggressive_1
  a :Aggressive;
  swc:hasStrength 90;
  .
:fighting_1
  a :Fighting;
  swc:hasStrength 90;
  .
```

From the aforementioned goals there are two that can be associated with aggression and the chance of a fight, namely `LookOutForEnemies` and `SearchAndKillVermin`. To make the association with fighting believable, it is assumed that both goals, once active, lead to the discovery of an opponent to fight with. To associate fighting and aggression with these goals, we have to add these motivations to the goal schema's list of motivations that are associated with these goals in a positive way (they increase importance):

```
positive_motivations([
  ':fighting_1',
  ':aggression_1'
]),
```

We now have created an aggressive pirate that likes fighting, together with some goals with which he can get the action he wants. It should not be surprising when this pirate is not going to sleep or drink but will opt for a potentially more violent course of action.

Description of the simulation
Running the simulation leads to two different stories: one in which the pirate starts to look for vermin and another in which the pirate climbs to the crow's nest to scan the horizon for possible enemies. The pirate's choices are easily explained by looking at the underlying importance calculations. Here we see that, since both goals are associated with the same motivations, the importance of both `LookOutForEnemies` and `SearchAndKillVermin` is `(90+90=)180`. With equal importance no goal is preferred over another and thus a random choice is made between them.

Directly after completion of one of the goals, the desire for the interest `fighting_1` is reset because the pirate has just satisfied this interest by fighting either vermin or other enemies. This means that the importance of the other goals that are associated with fighting have lower importance from this moment on. Personality strengths are fixed, so the strength of `aggression_1` does not change. Calculating importance for the goal that was not chosen until now would lead to a new value of `(90+90*0=)90`.

Discussion
This is the most simple of scenarios in which a pirate can choose from a number of goals the goal that suits him best. This scenario illustrates the core principles of motivational goal management: calculating goal importance and managing desire of interests. The pirate chooses a goal that suits his motivations and completion of that goal leads to a temporarily decrease of strength of the satisfied motivation (interest). Would the pirate have had another interest, like greed, that was a little less important than fighting, then after successfully completing the goal `LookOutForEnemies` a goal associated with greed would likely become more important than yet another goal associated with fighting. The desire management mechanism tries to keep characters from doing the same over and over again. Over time, the desire to fight will again increase (with `0.02` per round), which will likely result in more fighting-oriented choices of this pirate in the future.

4.1.2 Scenario 1B

Here the same setting applies as with scenario 1A. However, the former aggressive pirate has been replaced by a very lazy one that also happens to be paranoid.

Authoring
The pirate will be given lazy and paranoid as personality traits:

```
:pirate
  swc:hasPersonalityTrait :lazy_1;
  swc:hasPersonalityTrait :paranoid_1;

:lazy_1
  a :Lazy;
  swc:hasStrength 80;
  .
:paranoid_1
  a :Paranoid;
  swc:hasStrength 50;
  .
```

We will now extend the list of positive motivation for the goal `LookOutForEnemies` with the personality trait `paranoid_1`:

```
  positive_motivations([
    ':fighting_1',
    ':aggression_1',
    ':paranoid_1'
  ]),
```

The idea behind this is that the pirate wants to check whether he is safe or whether he should prepare for fight or flight. Also, we will associate the goal `Sleep` with laziness:

```
  positive_motivations([
    ':lazy_1'
  ]),
  negative_motivations([
    ':paranoid_1'
  ]),
```

Note that we have also put `paranoid_1` with the negative motivations for the goal `Sleep`. The idea behind this is that paranoia can lead to difficulty with sleeping, because... Well you just never know, do you? Here it is expected that the pirate will first check whether there are enemies nearby before he will even think of getting some sleep. It might seem strange that a goal that is associated with fighting and aggressiveness, is also preferred by a paranoid pirate, but in the story this makes perfect sense. When paranoia is the only motivation present, the other motivations associated with this goal do not play a role anymore in this situation.

Description of the simulation
The simulation produces a story where the pirate, as expected, starts by adopting the goal `LookOutForEnemies`. Initially the goal importance of this goal equals the strength of `paranoid_1` (which is `50`) since fighting and aggression

do not play a role here. This also means that the goal could lead to undesirable events (undesirable for the pirate, not for us as reader and/or author), like spotting an enemy and getting into a fight. The pirate however is not aware of this, since he only knows about his own motivations. The goal `Sleep` has initial importance of `(80-50=)30` and will therefore not immediately be chosen.

Discussion
Here we see how subtle changes in authoring can influence the simulation. When we assign the strengths of the motivations differently and would make the strength of paranoia `40`, then both goals would have equal importance (`40` and `80-40=40`). This would lead to a random choice between `Sleep` and `LookOutForEnemies` which makes it possible for the pirates of both scenario 1A and 1B to start with adopting the same goal (`LookOutForEnemies`) but for entirely different reasons. Decreasing the pirate's paranoia would obviously lead to a relatively bigger importance for `Sleep`.

4.1.3 Scenario 2A

A pirate and a captain are together on a ship. Because the ship is being followed by a dangerous enemy ship, the ship needs to sail faster to escape its pursuers. This can be achieved to lose ballast and hence the captain orders the pirate to throw the heavy treasure overboard. It's the pirate's move.

Authoring
First we will create the pirate character. As a starting point, we will take a pirate that is obedient and will be likely to do what his captain tells him to do. A corresponding personality trait could be `loyal`. Next he is also more than average attached to his life, which renders him the interest of `self-preservation`. Now both should be given a strength. The character's definition would now contain the following information:

```
:pirate
  swc:hasPersonalityTrait :loyal_1;
  swc:hasInterest         :self_preservation_1;

:loyal_1
  a :Loyal;
  swc:hasStrength 70;
  .
:self_preservation_1
  a :Self_preservation;
  swc:hasStrength 70;
  .
```

Assuming we have already authored enough goals for the pirate to choose from, we need to tag these options with personality traits and interests that are suitable in this scenario. To force the pirate to make exactly one decision on this matter (instead of choosing one alternative first and then trying the other as well) we also should group them as alternatives for this specific story situation by associating them to a dramatic choice.

Looking at the order of the captain ('throw treasure overboard') we have two obvious responses: do it or do not do it. The latter response is unlikely for our

character, because we have just defined him both loyal and self-preservative. Not dumping the treasure would be considered mutiny and would probably also lead to catching up by the enemy ship.

Looking at our pirate, our attention should mainly go to the obedient response, which could be a goal like `DumpTreasureInChaseAsOrdered`. This goal should be associated with loyalty and self-preservation in a way so that our character would be motivated to choose this goal. This means we have to add these motivations in the corresponding goal schema to the list of positive motivations. This would look like this:

```
positive_motivations([
  ':loyal_1',
  ':self_preservation_1'
]),
```

The disobedient response `DoNotDumpTreasureInChaseAgainstOrder` would in this case have the same associated motivations but with a negative impact on the importance of the goal, so they are added to the list of negative motivations of the disobedient response.

To make these goals part of a dramatic choice we add another tag to both goal schemas that are considered options for the pirate to choose from. This would look like this:

```
dramatic_choice(
  ':DumpTreasureChoice'
)
```

Description of the simulation
Executing this simulation renders a short story wherein the pirate is ordered to throw the treasure overboard. The pirate then decides to execute the order. The decision process in this scenario is very simple because the pirate has only one real alternative to choose from during this dramatic choice. He calculates the importance of both the obedient and disobedient responses, which will add up to `(70+70=)140` and `(-70-70=)-140` respectively.

Discussion
Because we have authored a loyal pirate who is attached to his own well-being, we expected him to obey his captain's order beforehand. The simulation offered no surprises and went analogous to our expectations.

An important matter here is the introduction of a dramatic choice tag. Without it, both options are ordinary goals to choose from, what would mean they could both be adopted and executed. To prevent this, they are grouped by the dramatic choice tag and when one option has been chosen and completed, the other options are dropped. Also, when a dramatic choice emerges, this is logged into the fabula so that later on, during presentation, this situation can be recognized and potentially be incorporated in the story in a special way. Handling of dramatic choices by the narrator is currently not yet implemented however.

4.1.4 Scenario 2B

Here we will consider the same setting as in the previous scenario, but now the pirate is not so easily parted with the treasure.

Authoring
The pirate in this scenario will be very greedy and does not think too much about getting hurt (which can be modeled by leaving out the self-preservation interest). Also the pirate is still loyal:

```
:pirate
  swc:hasPersonalityTrait :greedy_1;
  swc:hasPersonalityTrait :loyal_1;

:greedy_1
  a :Greedy;
  swc:hasStrength 90;
  .
:loyal_1
  a :Loyal;
  swc:hasStrength 70;
  .
```

We now need to associate greed with the two options of the previous scenario (`DumpTreasureInChaseAsOrdered` and `DoNotDumpTreasureInChaseAgainstOrder`). We will add greed to the negative motivations of dumping the treasure and to the positive motivations of not dumping the treasure. Below, we see the motivation lists for `DumpTreasureInChaseAsOrdered`. `DoNotDumpTreasureInChaseAgainstOrder` has the same lists but then the other way around.

```
  positive_motivations([
    ':loyal_1',
    ':self_preservation_1'
  ]),
  negative_motivations([
    ':greedy_1'
  ]),
```

Both options will still belong to the dramatic choice (`DumpTreasureChoice`) that was created in the previous scenario. Since we have assigned the highest strength to greed, this time we expect the pirate to defy his captain's order.

Description of the simulation
As expected, the pirate cannot be convinced to throw his dearly beloved treasure overboard. Dumping the treasure has importance `(70-90=)-20` and not dumping it has `(90-70=)20`. His greed is stronger than his loyalty, which motivates his insubordination.

Discussion
While the pirate is still loyal, his greed is stronger and takes over during the decision. Of course we haven't modeled any consequences of insubordination nor an eventual sea battle with the pursuing enemy. Incorporating these factors could change the pirate's mind and lead to a different outcome. We could also model another goal, like `HideTreasure` with which the pirate could satisfy both of his motivations: he is not defying his captain openly and can also keep the

treasure within reach. Would the strengths of loyalty and greed in the current situation be equal, it cannot be predicted what the outcome of the resulting internal conflict will be. Note that, without motivational goal management, this situation would lead to a random choice without much more to say about it. Instead we now have an internal conflict with a resolution yet unknown to us. In a later stage maybe we could derive emotions from such a situation where, in this case, greed and loyalty collide.

4.1.5 Scenario 2C

In the previous two scenarios we have only looked at the decisions of the pirate. In this scenario, during the chase the bold captain appears to be greedy, while the loyal pirate fears for his life...

Authoring
In the previous scenarios the captain always gave the order to throw the treasure overboard. Not because he wanted it, but because it was the only goal he could adopt. In this scenario we will also give the captain some motivations. To make things interesting let us try to author the captain in such a way that will ensure him not giving the order. A logical reason not to give the order would be that the captain is greedy, just like the pirate in the previous scenario. We will also make him bold, since the enemy ship still is catching up but this does not seem to worry our captain too much. The captain's character definition would then contain the following information:

```
:captain
  swc:hasPersonalityTrait :greedy_1;
  swc:hasPersonalityTrait :bold_1;

:greedy_1
  a :Greedy;
  swc:hasStrength 90;
  .
:bold_1
  a :Bold;
  swc:hasStrength 70;
  .
```

The pirate (as in scenario 2A), is loyal and attached to his self-preservation (both with strength `70`) and is also afraid (strength `20`).

Let's give the captain the choice between an order to dump the treasure (`OrderToDumpTreasureDuringChase`) and the explicit ordering of NOT dumping the treasure (`OrderNotToDumpTreasureDuringChase`). The first goal will have greed associated in a negative way:

```
  negative_motivations([
    ':greedy_1'
  ]),
```

The second goal will have greed and boldness associated in a positive way.

```
  positive_motivations([
    ':greedy_1',
    ':bold_1'
```

```
]),
```

We also tag both goals as part of dramatic choice `OrderDuringChase`.

The pirate's options are to respond to any order the captain will give him by doing it, or by defying the order. The responses to the order to dump the treasure are already discussed in the previous two scenarios. When the captain orders not to dump the treasure, the pirate can adopt a goal to go and guard the treasure or to defy this order and still dump it. As a result, we now have to model four different goals for the pirate to choose from:

1. `DumpTreasureInChaseAsOrdered`
2. `DoNotDumpTreasureInChaseAgainstOrder`
3. `GuardTreasureInChaseAsOrdered`
4. `DumpTreasureInChaseAgainstOrder`

Since the pirate is equally loyal and self-preservative, the fact that he is afraid is likely to push him towards insubordination.

Description of the simulation
The captain calculates the importance of his available orders and sees that keeping the treasure is the better choice (`(90+70=)160` versus `-90`). The pirate, starting to feel uncomfortable, has to think of something to do. Guarding the treasure is in line with his loyalty, but contrary to self-preservation and his fear `(70-(70+20)=-20`. Dumping the treasure is against his loyalty, but the better choice for satisfying his interest in self-preservation and to control his fear `(70+20-70=)20`.

Discussion
In this scenario, the pirate has to deal with a situation that is brought upon him by his captain. Without modeling consequences for insubordination, the pirate motivates the decision to throw the treasure overboard. Would the pirate not have been afraid, this would have resulted in an internal conflict. Would the captain not have ordered to keep the treasure, then the pirate would less hesitantly part with the treasure, because without the order it would not be considered an act of insubordination.

4.2 Scenario Summary

This section summarizes the previously presented scenarios. Table 4 contains for each scenario the used characters, their motivations and associated strengths and the outcome of the simulation. This table allows for a quick analysis of the consequences of some adjustments in the scenario settings.

4.3 Discussion

The scenarios in this chapter have illustrated how motivational goal management currently works in the VST. As we have stated in the methodology (section 1.4.1), to be able to evaluate the implementation, we should have a close look at

Scenario	Characters	Outcome
1A	Aggressive(90) pirate that likes fighting(90)	Choice for either `LookOutForEnemies` or `SearchAndKillVermin` (equal goal importance)
1B	Lazy(80) and paranoid(80) pirate	Choice for `LookOutForEnemies` over `Sleep` (safety first)
2A	Loyal(70) and self-preserving(70) pirate	Choice for following orders
2B	Loyal(70) and greedy(90) pirate	Choice for insubordination
2C	Bold(70) and greedy(90) captain, pirate of scenario 2A who is also afraid(20)	The captain wants to keep the treasure, but the pirate throws it overboard anyway because self-preservation and fear are more important than his loyalty

Table 4: A summary of the evaluation scenarios

both the characters' decision process and the authoring process that is needed to enable motivational goal management in the VST. The implementation should work correctly and authors working with the VST should be able to work with character properties such as personality traits and interests with relative ease. The following subsections will evaluate the work on these points after which we will also take a look at the stories now produced by the VST to discuss potential differences and new possibilities.

4.3.1 The Implementation

Let us start with the first part, the implementation. It can be concluded from the implemented scenarios that the different parts of the implementation (importance calculation and comparison, desire management and dramatic choice handling) work the way they are intended to do. Importance calculation of goals using strengths of personality traits and interests is working correctly as is determination of the most important goal. When a goal is attained, associated interests have their desire value reset. At the start of later goal importance calculations that involve interests with reset desire, the desire values of associated interests are updated. The new desire value is based on the number of rounds that has passed since they have been reset.

When a dramatic choice takes place, the goals related to the moment of choice are identified and assigned importance. At the same time, the dramatic choice is logged in the fabula. A dramatic choice fabula element is created and linked to the goals with which it is associated and with the event that led to the emerging of the choice. The best option in the choice is adopted for pursuit by the character and upon completion the other alternatives are dropped.

Summarizing the above, the implementation is working correctly. Additionally, it is also domain independent. Currently the VST is working in a pirate domain, but if this were to change, the implementation will not require alteration. It will work the same way with other motivations and dramatic choices. Finally it

is easily 'turned off'. When authors do not want to use motivational goal management, then they can just ignore it. When no personality traits or interests are assigned to the characters, goal management will work in the way it did before this research started.

4.3.2 The Authoring Process

The scenarios show that the authoring process is pretty straightforward; the characters need to be given characteristics, these have to be assigned strengths and they have to be associated with goals. Although we have not evaluated the authoring process by means of external authors, the general feeling is that it seems easy to understand how it works. You could say that the goal of making the authoring relatively easy to understand and use has been attained. Of course it then also has to be said that this can only be stated with certainty with respect to small story domains such as the ones illustrated by the scenarios. Bigger domains have not been authored yet and can therefore not be judged here.

The motivations we identified in the domain analysis are usable, but also somewhat restrictive. Thinking of psychologically correct, or universally accepted terms for personality traits and interests (like 'loyalty' and 'wealth') that would lead to the character behaviour we were after was a bit idealistic. Sometimes a story situation requires a very specific motivation and in such situations it is no crime to be a little more specific and use more illustrative and dramatically powerful terms. Authoring remains a creative process and the formulating of motivations, assigning strengths and associating a goal with motivations remain *choices* made by the author. There are no rules for this and no such choice can directly be classified as right or wrong; it completely depends on what the author has in mind for a specific situation. A strength of 40 for an interest like self-preservation has no clear meaning. You can associate loyalty with treason in a positive way if you want to. After all, automated story generation is also a form of art and the implementation of motivational goal management should not constrain the author in situations like these.

One might, however, want to keep some logic in the authoring decisions, which means thinking carefully about whether some association works in more than just this one situation. By giving a very specific meaning meant for use in a specific situation to a more general goal can have unforeseen effects that do not seem very believable when this goal emerges in other situations.

For example, take the goal `DumpTreasureInChaseAsOrdered` from scenario 2A and rename it to `DumpTreasure`, which effectively describes the course of events it sets in motion when adopted. Now look at a situation where there is a treasure aboard, but there is no chase by an enemy ship. Still, a pirate that has self-preservation as interest could be convinced he is saving himself from harm by throwing the treasure overboard because that goal is still associated with this interest. As the scenario shows, very specific naming of goals and thinking thoroughly about the reusability of goals can prevent a lot of these undesirable situations.

In this case, with the goal `DumpTreasureInChaseAsOrdered` we need to add the

precondition that a chase is really taking place to ensure this goal is only used in a situation where self-preservation really matters. Another option of handling this context dependency would be to use goal selection rules that state that a goal can only be chosen in a certain situation. This is in line with regulating character autonomy as discussed in section 3.1.2. Whether the enemy ship will really reach the pirate's ship and start a battle is not something we have to decide on beforehand. The pirate's expectation about future events is all that matters here. When he thinks (which means 'when the situation suggests') that not dumping the treasure results in physical harm, then that is enough justification for an association of the goal with self-preservation.

Another precondition for this situation, along with trivial ones such as the presence of a treasure, is of course that the order to dump the treasure has been given. Without these preconditions, the goal becomes too general to use with loyalty and should be given a less specific name. Often it will be the case that multiple goals like these exist together in the goal base of the story domain. While all of them can be attained by the same sequence of actions, the context of the situation (defined by preconditions) determines which goal will be used and what role a character's motivations play therein.

Aside from the point that authoring the use of motivational goal management appears to be relatively easy to do, the influence of authoring on the way the simulations progress seems clear. Too clear maybe, because when looking at the scenarios, the outcome always seems directly in line with our expectations beforehand. This can be judged undesirable since part of the charm of automated story generation lies in the fact that with autonomous characters practically anything can happen within the limits of the domain. Of course, so far we have only seen scenarios that outline one particular situation in which the characters are specifically authored to prefer a certain course of action. I assume that when we extrapolate our current observations to a bigger domain with more characters, motivations, goals and thus more possible choices, the measure in which we can predict exactly what will happen will decrease. This assumption seems to be confirmed in [42].

4.3.3 The Stories

So far we have seen how the implementation of motivational goal management works and what effects authoring can have on the simulations, but what effects does motivational goal management have on the stories? The VST is a story generation application after all, so are there any differences with the stories that were produced before this research started?

Actually, at the current moment there is not much difference to note. The presentation layer has not been touched during this research, which means that there are no structural changes in story production. However, the fabula has been extended to incorporate a structure for dramatic choice. When a dramatic choice occurs, it will be logged in the fabula. While nothing is done with this at the moment, with a little work it will be possible for the presentation layer to take this information into account. During narration, interesting aspects of the choice can then be told as part of the story. For example, the reader could

be presented with the following story fragment:

"The ship had caught fire. Erik had the option to abandon the ship immediately or to try and extinguish the fire to be able to save the treasure. Erik..."

Compared to:

"The ship had caught fire. Erik jumped overboard."

A somewhat more subtle effect of the implementation is not in the story itself, but in the experience the reader of VST stories. While no user studies have been conducted, from the scenarios it can be concluded that with self-motivation the VST characters now have an extra dimension which makes them potentially more interesting than before. Independent from the integration of dramatic choice in the VST's presentation layer, from now on the reader knows that the characters motivate their behaviour. Therefore, the choices made by the characters can make the reader think about their characteristics. The knowledge about the available options during dramatic choices and maybe some information about the character's personality and interests could facilitate the reader's immersion in the story and allow him/her to react with empathy to the character or its situation more easily.

Also, with motivational goal management the author now has an extra authoring dimension to his disposal. Assuming that motivational goal management will be commonly used in the future stories of the VST, this can have certain consequences for the stories. Now that we are able to let characters motivate their choices and think some situations through, it just might be that future stories will focus more on inner conflicts and the effects of clashing motivations. Additionally, now that characters have personality traits, maybe we can create stories that contain characters that change their personality over time. This could lead for example to plots in which some character is evil at first but eventually turns to good.

While not currently present in the VST, emotional behaviour has proven to be an important part of believable characters (see section 2.2.2). Now that self-motivation has been realized, it can provide a good starting point for the implementation of emotions in the VST. Characters can now associate importance to things that happen in the story world and can therefore appraise the outcomes of actions and events better than before. Besides importance, the characters also know which motivations are concerned during appraisal, which help determine emotional states. For example, when a character greatly values self-preservation, and a goal facilitating self-preservation fails, the character will know that his health is in danger. Appraisal of this situation should result in some measure of fear arising with this character. This in turn also should depend on the personality of the character, since a fearless pirate like Redbeard will respond differently to looming health hazards. Consequently, VST stories incorporating the concept of emotion seem more tangible with the realization of motivational goal management.

In short, at the moment, the VST's stories have not changed since the start of this research. Although Redbeard stories are still beyond our reach, the current stories do have the potential to be enhanced in a number of ways in the near future.

5 Conclusions & Recommendations

This chapter will conclude this thesis about the work that has been done on the Virtual Storyteller during the period of this research. In the following sections we will look at the extent to which the research goal has been attained and will identify what is still left to be done. Also some recommendations will be given for possible future work in this area.

5.1 Conclusions

In this thesis a trait-based approach of motivational goal management for the Virtual Storyteller has been presented and evaluated. The work proposes an implementation solution (based on the PSI theory) to the goal of providing the VST characters with self-motivation in order to enable them to make informed decisions based on their characteristics.

This research started with examining the context of the field of automated story generation and have looked at some applications, including the VST itself. Examining narratives more closely and searching for factors that make stories more interesting led to the need for self-motivation in believable characters. Next, personality traits and interests have been identified as the main factors of self-motivation. Furthermore, because of the story domain the VST currently uses, a domain analysis of pirate stories has been conducted. During the analysis we have looked at a number of pirate stories and extracted themes and settings, typical objects, personality traits, interests and emotions from them. Ultimately this analysis has provided us with a feeling for typical pirate motivations and scenarios in which they can be used.

Part of this data, together with the use of personality traits and interests as components of motivation has resulted in a motivational goal management algorithm. Motivational goal management now enables VST characters to reason about events in the world in terms of importance through which they can make decisions based on their motivations. A process of desire management refines motivation by lowering importance of recently satisfied motivations.

In addition to the character's self-motivation, the VST's fabula model has been extended to incorporate dramatic choice. The dramatic choice data structure embodies an interesting branching point in the storyline where characters are posed with choices that are often exclusive. The choice is dramatic because the choice for one course of action will exclude other options from the story. Dramatic choice has been integrated in the VST's fabula structure allowing the presentation layer to incorporate such situations in the VST's stories in the future. The stories will then be able to communicate a character's choices and motivations to the reader.

The approach to motivational goal management has been evaluated using several story scenarios (based on the domain analysis) that illustrate the working of the goal management algorithm and the authoring process. Both the implementation and its manageability by the author conform to the expectations that

existed beforehand. The process of motivational goal management is effective and has been kept relatively transparent. The authoring of motivational goal management can be done with relative ease and closely resembles the authoring needed for other aspects of VST simulations. Additionally, the general feeling about the effects authoring has on the simulation is intuitive for the small scenario domains.

Very shortly put, when we compare the situation prior to this research with the situation after, we see that where previously characters chose randomly between possible goals, characters now take informed decisions based on what is important to them and their current situation. Although it still requires some work to be able to express this more explicitly in the VST's stories, currently the reader should already be able to get some insight in the mind of the characters.

5.2 Recommendations For Future Work

Several areas of future work can be identified. These include further implementation of motivational goal management, enhancements of VST in general and the use of motivational goal management as a basis for further work on believable characters.

5.2.1 Further Refining Motivational Goal Management

During the work on the implementation a lot of ideas beyond the current scope (as defined in section 3.3.1) arose. Up to this point they have not been implemented, since most of them require some more research before they can be used correctly. I will present the most relevant of these ideas here.

The information the strengths of motivations gives us can be used in other ways than just for calculating goal importance, for instance for conflict recognition. When the sums of positive and negative motivations associated with a goal are equal, this will result in an importance of zero. Instead of just regarding this as an unimportant goal, the implementation could regard this as an interesting situation. It will depend on which motivations are playing a role here and also on their strengths to be able to determine whether this is a situation that represents a personal conflict. For instance, when loyalty and greed have about the same strength, but the first belongs to the positive motivations of a goal and the other to the negative, we have a conflict. Since conflicts are important in dramatic narrative, now that we are able to detect them, they should eventually become part of the VST's stories.

In section 3.3.2 we have discussed the switching of goals. Currently this is only done when something more urgent comes up. However, when a goal is interrupted by another more urgent goal and this urgent goal has been completed, there is no way to take up the interrupted goal and continue with the execution of its associated plan. This is not a shortcoming of motivational goal management, but of the VST's goal management in general. More research about issues such as storing a partly finished plan is necessary to solve this problem.

In addition to switching due to urgency, it would be plausible to consider changing one's course of action when a clearly better alternative for the current goal emerges. A simple illustration of such a situation would be a pirate that pursues wealth. While he is underway to the dangerous island to search for uncertain treasure there, he receives a message that he has won the lottery. The only thing to claim his prize is to sail back to his home port and collect it. It would be very believable would the pirate abandon his dangerous endeavour and sail back to port. In a similar situation where only one goal can be adopted, but this has very negative results for the character, the character should have the option to refuse to adopt this goal. However believable, decisions such as these might not be very beneficial for the story. It seems that believable behaviour and interesting stories are connected by some kind of a trade-off. We will get back to this later.

A more straightforward recommendation is to increase desire of interests that are neglected (not satisfied) over time. At the moment, satisfied interests have their desire set to zero, after which it grows back. The main reason to implement this was to keep characters from choosing the same course of action over and over again. Also increasing desire of motivations that are not satisfied over a certain period of time helps the current implementation even more. Still some research is required to determine whether all interests are suitable for this.

Extending desire management some more, we could think of differences in the measure of regrowth between different interests. This measure of regrowth could be modeled with the interest itself and be taken into account in the calculation when updating these desires. It could also be possible that desire of some interests need not be reset to zero, but should be halved when satisfied. More research is needed to identify which type of interest should have with measure of regrowth. Maybe interests can even be categorized based on such properties.

Currently motivations are associated with goals. After goal adoption, a plan to achieve the goal is made without keeping these motivations in consideration. I feel it would benefit believable behaviour when motivations are also associated with actions. Adoption of a goal to eliminate someone motivated by revenge is believable, but planning a cowardly stab in the back or daring the opponent to a honorable duel takes the influence of motivation on behaviour one step further. Of course, such behaviour can already be realized by creating two different goals, but essentially they are both the same goal, with a different possible plans. Action-motivation can be implemented through preconditions of actions or through plan evaluation with respect to a character's traits, of which the first option is most tangible.

There are situations where a dramatic choice arises, but where the choices a character has are not all exclusive choices. Another, not so exclusive, example of dramatic choice is a ship that catches fire. The pirates on the ship can either opt for trying to extinguish the fire, or to abandon ship. Abandoning the ship first and climbing back aboard to fight the fire is not very believable, but the other way around would not be that strange.

This implies the need for ordering constraints for the goal associated with dramatic choice which should result in more intelligent goal management. Currently, when one alternative with dramatic choice has been completed, the other

alternatives are dropped. With ordering constraints we could say things like the following about the aforementioned example: when jumping overboard is chosen, then we have to drop the goal to extinguish the fire. When extinguishing the fire is chosen, then jumping overboard is still possible.

5.2.2 Enhancing The Presentation Layer

To be able to express dramatic choice in the stories of the VST, the presentation layer should be adapted to recognize and respond to an occurrence of dramatic choice. Here it is important to first think of how you would want to see dramatic choice emerge in the story itself. Do you want to read about all possible choices, or should the focus be on the most important motivations that led to a certain choice? Both are presented below.

"The pirate that liked animals decided to hide the rat."

"The pirate that liked animals decided to hide the rat instead of killing it as was ordered by the captain."

Of course they can also be combined:

"The pirate had to choose whether he would hide the rat or kill it as ordered."
"Since he liked animals a lot, he chose to hide the rat."

In the previous section we encountered a trade-off between character believability and the quality of the story. There are situations where a character would prefer a cautious route, while we as author and reader, would prefer the dangerous route. It is important to note that autonomous believable characters do not aim for interesting stories. Therefore, the VST's stories would benefit from something as an 'interesting story bias' where decisions are monitored and sometimes characters a pushed gently upon a more interesting path. This seems a responsibility that would suit the Plot Agent although one could also think of an out of character solution in the Character Agent as proposed by Swartjes [41]. Of course, since it is a trade-off we are talking about here, interferences like this could go at the expense of the believability of the characters, which makes it (again) a subject of research.

5.2.3 Towards An Emotion Model

Earlier in this thesis (see section 2.2.2) we have identified emotional behaviour to be a very important part of believable behaviour. As was also observed during the discussion of the evaluation (in section 4.3.3), now that self-motivation has been realized, it can provide a good starting point for the implementation of emotions in the VST. A short overview of my ideas about this is presented below. While these ideas are still fairly abstract, they are more concrete than they possibly could have been before the start of this research.

There are several aspects of simulation in the VST that can evoke emotion, like:

- the outcome of goals
- conflicts (internal or external)

- events that concern a character's motivations (like another character's actions)
- location (a dangerous place, or a place that brings back memories...)

Characters can appraise the things that happen in the story world with respect to their motivations and adjust their emotional state accordingly. Satisfaction or violation of motivation then produces the emotion. A very important goal that is attained should have a positive effect on a character's emotional state. Internal conflicts can throw a person off balance and often leads to hesitation or confusion. External conflicts introduce a rival character to which angry responses are possible. An event that threatens a certain motivation should render a negative emotion.

These are all examples of cases that allow for introduction of emotion in the VST's stories. In addition to context of the situation, a character's motivations will also influence the kinds of emotions that will be evoked. An external conflict where another character threatens the well-being of another character could lead to fear, or anger, or both. A frightful character will likely generate fear and flee, while a merciless character will be overjoyed at the opportunity to defend himself.

A Redbeard Analyses

This appendix contains the six story analyses of the five (one is reviewed twice) Redbeard comics that were performed to obtain more information about pirate story content. Three people helped by performing the analysis of one or more comics individually. The identified content is gathered for use within the pirate domain of the Virtual Storyteller. The analyses, as are the read comics, are in Dutch. The results of the analyses in next appendix are also in Dutch and have a reference to the specific analysis they are obtained from. The terms encountered in the tables below are not necessarily literally extracted from the story text, but can just as well be the result of the interpretation of the story analyst. Section 3.2.2 of the thesis contains the most important and usable results translated into English.

A.1 Het Gebroken Kompas(1)

Reviewer: Ivo

Verhaallijn
Bij het plunderen van een Spaans galjoen blijkt tussen de kostbaarheden ook een klein kind op het schip aanwezig te zijn, dat Roodbaard adopteert als zijn zoon. Ontsnapt van de Spaanse achtervolgers meren Roodbaard en zijn mannen aan bij hun thuishaven, een eiland in de Caribische zee. Erik, zoals Roodbaard zijn zoon gaat noemen, groeit op en Roodbaard wil dat hij les krijgt van de beste leraren die er zijn. Het piratenschip reist af naar Cartagena, om een aantal van deze leraren te ontvoeren. Ook ontvoeren ze de zoon van de onderkoning, Don Enrique. Maar slim dat de leraren zijn, verzinnen ze een list. Roodbaard moet om het Caribische zeegebied heen varen om niet in handen te vallen van de Spanjaarden, maar op instructie van de leraren maakt Don Enrique de reservekompassen onklaar en beinvloedt met een magneet het navigatiecompas. Ook vergiftigen ze het water, waardoor Roodbaard aan land moet. Als Roodbaard erachter komt dat de boel gesaboteerd is door Don Enrique, wil hij hem direkt van de loopplank laten, maar bedenkt zich en gebruikt hem als schild. Bij het halen van water op een eiland worden ze ontdekt door de Spanjaarden. Een achtervolging volgt, en bijna komen Roodbaard en zijn mannen in handen van de Spanjaarden. Dan bedenken ze een manier om de Spanjaarden vertraging te bezorgen; ze zetten Don Enrique en de leraren op een zinkende reddingsboot zodat de Spanjaarden - volgens de zeewet - verplicht zijn hen hulp te verlenen. Zo komen ze weer veilig terug in hun thuisbasis.

Motivatie verhaallijn
Het verhaal start vanuit een stereotype piratenhandeling (het plunderen van een schip) en vanuit hier ontstaat de specifieke verhaallijn door de inciting event: het vinden van het kind. Hier krijgt Roodbaard een affectie voor (emotie) die de koers van de rest van de verhaallijn uitzet. Het opgroeiende kind heeft educatie nodig en dit stuurt Roodbaard en zijn mannen terug het gevaar in.

Karakters

Roodbaard (rode paardenstaart en ooglapje) is de onverschrokken en doortastende kapitein van een piratenschip. Hij spaart niemand en er valt niet mee te onderhandelen (p.5). In het plunderen van het Spaanse schip zie je hem soms met pistool en degen, soms met twee zwaarden, dan weer met n zwaard. Zijn affectie voor het kind komt voort uit het feit dat hij het lachen van het kind interpreteert als uitlachen. Roodbaard vind dit geweldig; dit is de eerste persoon die "niet siddert van angst als hij roodbaard ziet". Verder had hij er altijd al van gedroomd een zoon te hebben die hem waardig is. Roodbaard duldt geen discussie over zijn orders, en geen tegenspraak. Veelgebruikte uitdrukking: "Alle bokkepoten!"

Don Enrique is de prototypische rijkaard: zoon van de onderkoning, verwaand maar wel laf. Dit uit zich in angst (bv als hij op een vat kruit vastgebonden hebben om te voorkomen dat de Zwarte Valk beschoten wordt door de Spanjaarden). Als men achter zijn list komt en hij van de loopplank geduwd wordt, zegt hij: "Genade! Mijn vader zal losgeld betalen!" waarmee hij – laf – de piraten probeert om te kopen zijn leven te sparen.

Technieken
Aftocht dekken door verwarring te zaaien (bv gebouwen in brand steken). Het nemen van gijzelaars. Als drinkwater op is of vergiftigd, moet men aan land. Als de wind gaat liggen, gaat het schip niet vooruit. Omkopen van inboorlingen om te verklikken als piraten aan land gaan. Afsteken van waarschuwingsvuren trekt de aandacht van andere schepen.

Emoties
Dit is een vaak terugkerend thema: risicovolle beslissingen door Roodbaard, een twijfelende bemanning (angst) en woede van Roodbaard over het niet opvolgen van zijn orders. Na deceptie door de piraten voelen achtervolgers zich vernederd ("de hele bemanning lacht zich naar")

Emotie-eigenschappen
Expressie "Bij de poten van de duivel!" (angstige verbazing), "Verdraaid!" (frustratie). "Hier zitten, stuk verdriet!" (ergernis)

A.2 Het Gebroken Kompas(2)

Reviewer: Mariët

Enkele aanvullingen op de review van Ivo:

Verhaallijn
Terugkerende thema's zijn het achtervolgd worden van de Zwarte Valk (Roodbaards schip) door zwaarbewapende (Spaanse) galjoenen die hen de grond in willen boren. Tot twee maal toe weet Roodbaard aan de achtervolgers te ontsnappen door alle mogelijke ballast – tot zelfs de kanonnen aan toe – overboord te gooien zodat het schip lichter wordt en daardoor sneller / door ondiepere wateren kan varen dan de achtervolgers.

Karakters
Roodbaard is een prototypische piraat zonder mededogen voor zijn slachtoffers. Moed kan hij echter wel waarderen (dit is ook de enige reden dat hij het kind

spaart en adopteert). De aangenomen zoon Erik blijkt echter geen typische piraat te zijn in de zin dat hij wel een geweten heeft en niet houdt van onnodig bloedvergieten. Typerende uitspraak als Roodbaard Enrique van de plank wil laten lopen (en Erik dit tegenhoudt): "We zijn geen misdadigers!"

Conflicten
Uiterlijke conflicten zijn er tussen de piraten en hun slachtoffers en de piraten en hun achtervolgers. Daarnaast vinden we in dit verhaal ook enkele innerlijke conflicten. We lijken het begin te zien van een innerlijk conflict bij Erik: enerzijds houdt hij van zijn vader, aan de andere kant veroordeelt hij diens bloeddorstigheid. De bemanning van Roodbaard wordt heen en weer geslingerd tussen vertrouwen in hun kapitein en twijfel aan zijn beoordelingsvermogen. Roodbaard zelf lijkt geen last te hebben van innerlijke conflicten.

A.3 De Schrik Van De Zeven Zeeën

Reviewer: Mariët

Verhaallijn
Dit is het vervolg op Het Gebroken Kompas. Erik is inmiddels vrijwel volwassen. Roodbaard wil dat Erik onder een valse naam gaat studeren aan de Zeevaartschool in Londen. Maar eerst neemt Roodbaard hem mee op een uitgebreide plundertocht. Het piratenbestaan staat Erik echter zo tegen dat hij zich, eenmaal in Londen gearriveerd, voorneemt om niet meer terug te keren naar zijn vader. Op de Zeevaartschool heeft Erik het zwaar. Akelige verhalen over Roodbaard doen de ronde en hoewel Erik de daden van zijn vader afkeurt, voelt hij zich toch verplicht voor hem op te komen. Het gevolg is dat hij gestraft en gepest wordt. Op een dag hoort hij dat Roodbaard gevangen is genomen en in Londen wordt vastgehouden. Door een list weet Erik hem te bevrijden, maar neemt vervolgens alsnog afscheid van Roodbaard. Bij zijn terugkeer in Londen blijkt echter dat hij gezocht wordt, en hij weet ternauwernood de stad te verlaten als verstekeling aan boord van een schip. Wanneer hij tevoorschijn komt laat de tiran van een kapitein hem opsluiten om de premie die op zijn hoofd staat op te kunnen strijken. Terwijl Erik gevangen zit breekt muiterij uit. Erik wordt door de muiters als kapitein aangesteld, omdat hij de enige is die iets van navigatie weet. Echter de muiters blijken het zeeroverspad op te willen gaan, en met een klein clubje getrouwen weet Erik in een sloep te ontsnappen. Zij stuiten op een schijnbaar verlaten Frans schip waarvan de bemanning ziek of dood blijkt te zijn vanwege scheurbuik. Ze nemen het schip over en gaan op zoek naar de kust om vers voedsel in te slaan.

Motivatie verhaallijn
Bepalende motivaties in dit verhaal zijn loyaliteit (van Erik jegens zijn vader, waardoor hij hem verdedigt en later bevrijdt) en principes (Erik veroordeelt het piratenbestaan, waardoor hij niet bij Roodbaard wil blijven en ook niet bij de muiters). Roodbaard wil het beste voor zijn zoon waardoor hij hem naar de Zeevaartschool stuurt. Hebzucht is een belangrijke motivatie voor de daden van de kapitein en van de muiters, en natuurlijk ook van Roodbaard en zijn piraten. Roodbaard zelf lijkt daarnaast (om onbekende reden) ook door haat jegens de maatschappij te worden gemotiveerd.

Karakters
Erik: trouw aan zijn principes en aan zijn vader. Roodbaard is meedogenloos maar wel met eergevoel. Kapitein en muiters zijn wreed en hebzuchtig.

Emoties
Erik is boos op zijn klasgenoten omdat die zijn vader beledigen. Hij is trots op zijn vader, vanwege diens eergevoel en zijn kwaliteiten als zeeman, maar veracht hem tegelijk vanwege zijn misdaden. Uiteindelijk is de intensiteit van Eriks loyaliteit en trots het sterkst. Roodbaard is trots op zijn zoon omdat hij goed kan studeren en omdat hij hem bevrijdt uit gevangenschap. De muiters haten de kapitein omdat die hen wreed en tiranniek behandelt. Ze haten hem zo intens dat ze aan het muiten slaan en de kapitein zelfs vermoorden. Erik veracht de kapitein en ook de muiters vanwege hun hebzucht en wreedheid.

A.4 De Jonge Kapitein

Reviewer: Mariët

Verhaallijn
Dit is het vervolg op De Schrik van de Zeven Zeeen. Met zijn kleine bemanning arriveert Erik aan de Afrikaanse kust. Als ze aan land gaan om voedsel in te slaan wordt de scheepsjongen gevangen genomen door een Afrikaanse stam, de Batateken. Het opperhoofd, Kolibango, wil de scheepsjongen alleen uitleveren als Erik de vrouwen en kinderen terugbrengt die zijn ontvoerd door slavenhandelaars. Erik ontdekt het slavenschip en wil de slaven vrij kopen. Als de slavenkapitein probeert hem te bedriegen dreigt Erik het slavenschip (met hemzelf erbij) te laten ontploffen door zijn pijp boven een kruitvat te houden. Onder druk laat de kapitein de slaven alsnog vrij, en Erik weet van het slavenschip te ontsnappen. De scheepsjongen wordt vrijgelaten en Erik wordt bloedbroeder van Kolibango. Intussen valt het slavenschip het schip van Erik aan. Met de kleine bemanning maken ze geen schijn van kans, maar op het laatste moment komen de Batateken te hulp en worden de slavenhandelaars overwonnen. Erik verkoopt het slavenschip en brengt zijn schip terug naar Frankrijk, waar hij alsnog zijn kapiteinsdiploma haalt. Op de avond van zijn diploma-uitreiking krijgt hij onverwacht bezoek van Roodbaard! Deze probeert Erik opnieuw te overtuigen om piraat te worden, maar tevergeefs. Om zijn schuld aan Erik te vereffenen vertelt Roodbaard hem over zijn ware afkomst, als zoon van een rijke Franse edelman. De erfenis waar Erik recht op heeft blijkt door een ander te zijn ingepikt. Het begin van een nieuw avontuur...

Motivatie verhaallijn
Trouw, loyaliteit en eergevoel zijn opnieuw belangrijke thema's. Erik gaat af op de slavenhandelaar om zijn scheepsjongen te redden. Nadat Erik de slaven heeft bevrijd, helpt Kolibango hem op zijn beurt uit de nood. En aan het eind van het verhaal helpt Roodbaard Erik om op zijn beurt zijn schuld te vereffenen (omdat Erik hem eerder had gered).

Karakters
Erik, welbekend. Slavenhandelaar: stereotype hebzuchtig en gemeen. Kolibango: nobele wilde.

Emoties
Erik is bang dat de Batateken hem gaan vermoorden. Hij maakt zich zorgen over het lot van de scheepsjongen en als hij in de val lijkt te zitten op het slavenschip. Erik en de bemanning zijn bang als het slavenschip hen dreigt te enteren en opgelucht als de Batateken hen komen helpen. De Batateken ervaren verdriet en woede om hun vrouwen en kinderen en zijn wraakzuchtig tegenover de slavenhandelaren. Er zijn diverse momenten van verrassing, bijv. als Roodbaard opdaagt. Gezichtsuitdrukkingen zijn erg expressief en wisselen snel van het ene plaatje op het andere.

A.5 De Schat Van Roodbaard

Reviewer: Jasper

Verhaallijn
In een vorig verhaal is de schuilplaats van Roodbaard verwoest, daardoor zitten de Roodbaard, zijn (stief)zoon Erik, Baba en Driepoot nu vast op een onbewoond eiland. Ze worden ontdekt en opgepikt door Stark Le Noir de/een aartsvijand van Erik en Roodbaard. Le Noir is uit op de schat van Roodbaard, die legendarische omvang zou hebben. Le Noir zet Erik, Baba en Driepoot op een onbewoond eiland en gaat met Roodbaard achter diens schat aan. Tijdens een woeste storm spoelt een verlaten schip aan op het eiland waar Erik, Baba en Driepoot vastzitten, waarna het drietal ontsnapt op een vlot gebouwd van wrakhout. Ze dobberen een tijdje rond en net als het er slecht uit gaat zien worden ze toevallig opgepikt door Eriks oude schip inclusief bemanning. Erik neemt het commando over en zet de achtervolging in op Le Noir. Ondertussen arriveren Le Noir en Roodbaard in de regio waar de schat begraven is. Het is er een doolhof van ondieptes, zandbanken en kleine vaargeulen. Roodbaard overtuigt Le Noir dat alleen hij het schip veilig door de lagunes kan sturen, vervolgens laat hij het schip vastlopen. Erik en zijn bemanning hebben het schip lichter gemaakt en arriveren niet lang daarna op dezelfde plek. Le Noir ziet hen naderen en bedenkt een ingenieuze list. Eriks schip vaart dezelfde lagune binnen en ontdekt Le Noirs schip, dat verlaten oogt Op het dek vinden ze een briefje waarin Le Noir suggereert de schat al te hebben en Roodbaard op die plek een paar dagen geleden levend begraven te hebben. Erik, Baba en Driepoot gaan naar de plek van de schat om Roodbaard te proberen te redden. Le Noir laat een paar man Roodbaard bewaken en gaat met de rest Erik achterna, ontdekt zo de schat en neemt Erik en de rest gevangen. Roodbaard wordt ondertussen gered door inboorlingen, wie hij in het verleden geholpen heeft. Le Noir en zijn mannen lopen in een hinderlaag van de inboorlingen Erik en zijn mannen worden ook gered door inboorlingen. In het strijdgewoel denkt Le Noir te ontsnappen, maar zinkt in het drijfzand.

Motivatie verhaallijn
Hieronder een paar belangrijke punten uit de verhaallijn, met de achterliggende motivatie:

- Stark le Noir wil de schat uit hebzucht, bovendien heeft hij door een gebeurtenis in het verleden een hekel aan Erik.

- Roodbaard wil zijn schat niet aan Le Noir geven, maar aan zijn zoon Erik, uit o.a. liefde voor zijn zoon en haat voor zijn vijand.
- Tot twee keer toe willen mensen van een onbewoond eiland ontsnappen om te overleven. Ze maken hiervoor o.a. een vuur om de aandacht te trekken en een vlot om te kunnen wegvaren.
- Le Noir wil informatie over de schat en zet de piraten daarom een paar dagen in het ruim zonder drinkwater.
- Roodbaard wil zijn zoon in leven houden en krijgt met een list voor elkaar dat ze van boord van Le Noirs schip worden gezet.
- Een punt van kritiek: een pelikaan wordt water gegeven omdat hij bewusteloos is, uit medelijden??? Terwijl Erik, Baba en Driepoot op een onbewoond eiland zitten met weinig voedsel en drinkwater? Alleen om er toevallig achter te komen dat het drinkwater vergiftigd is. De schrijver kon blijkbaar niets beters bedenken.
- Erik zet de achtervolging in op Le Noir om zijn vader te redden.
- Roodbaard overtuigt Le Noir dat alleen hij het schip veilig door de lagunes kan sturen, vervolgens laat hij het schip vastlopen. Het listige idee hierachter is dat Roodbaard liever zijn leven geeft en Le Noir in zijn ondergang meesleurt dan hem de schat te geven.
- Le Noir besluit Roodbaard te verminken (wraak)
- Dit gaat niet door vanwege het arriveren van Eriks schip, waarbij Le Noir zich afvraagt hoe dit in godsnaam mogelijk is (verrassing, angst).
- Le Noir bedenkt een slimme list om de schat toch in handen te krijgen en om uiteindelijk ook Eriks schip te kunnen veroveren om weer weg te komen.
- Erik trapt in de list omdat de vrees voor zijn vaders leven hem verblindt en gaat proberen hem te redden.
- De inboorlingen redden iedereen, omdat Roodbaard hen in het verleden geholpen heeft en omdat Le Noir ze bedreigd had.

Karakters
Roodbaard, Blank, lang rood haar in een vlecht, rode baard, ooglapje.
Erik, (stief)zoon van Roodbaard, Blank, wit lang haar in een vlecht.
Baba, Zwart, groot en sterk.
Driepoot, Blank, klein oud mannetje met grijs haar in een vlecht, houten been.
Stark le Noir, Blank, korte zwarte puntbaard.

Emoties
Een aantal emoties en eigenschappen van piratengedrag keren vaak terug in het verhaal: Piraten zijn over het algemeen vrij meedogenloos en uit op eigen gewin. Eer speelt een belangrijke rol bij piraten. Ze zweren bepaalde dingen en houden zich daar ook aan. Ook laten ze iemand van hun groep niet achter om te sterven. Wanneer piraten gedwarsboomd worden in hun plannen worden ze altijd woedend. Ook bij extreme tegenslagen slaat verdriet meteen om in

woede en wraakzucht. Hieronder een aantal concrete emoties, geassocieerd met specifieke karakters en situaties uit het verhaal:

- Driepoot is vaak pessimistisch danwel wanhopig wanhopig bij tegenslagen. Dit is het enige karakter dat zo op dergelijke situaties kan reageren, de rest wordt boos, wraakzuchtig of verzint ter plekke een oplossing.
- Piraten zijn bij het signaleren van een schip altijd op hun hoede zolang ze niet weten wie zich erop bevinden.
- Bij beloftes van rivaliserende piraten is altijd wantrouwen te bespeuren. Eer is belangrijk, maar vooral bij je eigen bemanning.
- Stark le Noir is in eerste instantie verbaasd en dan bang als Eriks schip totaal onverwacht in zicht komt. Vervolgens wordt hij zelfingenomen met zijn bedachte list.
- Erik is verdrietig en boos als hij Le Noirs brief leest, maar vervolgens hoopvol als hij bedenkt dat Roodbaard nog in leven kan zijn.
- Le Noir is erg blij dat Erik in zijn list trapt met de schat en een nieuw schip in het vooruitzicht
- Erik ontdekt dat hij is bedrogen en is vervuld van afschuw/afgrijzen, dit slaat meteen om in woede.
- Over het algemeen speelt angst nauwelijks een rol bij piraten, maar zelfs piraten zijn in drijfzand doorgaans vervuld met doodsangst.

Samengevat komen de volgende emoties/gevoelens duidelijk naar voren: wanhoop, wantrouwen, afschuw/afgrijzen, hoop, woede, wraakzucht, verdriet (al wordt dit meestal direct verwerkt met woede), blijheid, opluchting, zelfingenomenheid (o.a. bij geslaagde listen), (doods)angst en behoedzaamheid.

Emotie eigenschappen
In het algemeen worden alle emoties enorm intens beleefdmaar slaan erg snel om. Er zijn wel een aantal langlopende emoties geassocieerd met de doelen die de verhaallijn bepalen, bijvoorbeeld hoop om Roodbaard te reden bij Erik, hoop om de schat te vinden bij Le Noir, de haat jegens Le Noir bij o.a. Erik en Roodbaard. Expressie: Piraten hebben een aantal krachttermen tot hun beschikking, waarvan Alle bokkepoten!, Duivelskaters! en Verduiveld nog aan toe! voorbeelden zijn. Gebruik van uitroeptekens is vereist. De illustraties tonen ook altijd verschikte, dan wel anders toepasselijk vertrokken gezichten en expressieve lichaamstaal.

A.6 Muiterij Op De Oceaan

Reviewer: Jasper

Verhaallijn
In een vorig verhaal blijkt Erik ten onrechte veroordeeld te zijn en bevindt zich dientengevolge nu als roeislaaf op een Frans oorlogsschip. Dit schip wordt uitgezonden om de beroemde corsicaanse barbaar Omar-el-Hadj van de zee te verdrijven. Deze Omar overvalt al lange tijd Franse handelsschepen en daar

heeft men van Franse kant nu genoeg van. Voor het schip vertrekt worden de laatste slaven aan boord gebracht, onder wie Baba zich bevindt. Baba wordt naast Erik op de roeibank geplaatst. Tijdens een storm helpt een voormalig scheepsjongen van Eriks bemanning (die gezworen had Erik niet meer te verlaten) Erik en Baba aan een vijl om hun boeien mee door te vijlen. Ondertussen hebben de mannen van El-Hadj, de Turken, door wat het Franse schip van plan is en Omar bedenkt een list. De Fransen worden meegelokt naar een baai waar ze vervolgens worden ingesloten door het schijnbaar vluchtende schip van Omar-el-Hadj en zijn uit het niets opduikende vloot. In de verwarring die ontstaat tijdens het eerste kanonsalvo beginnen de slaven onder aanvoering van Erik hun muiterij. Na zich te hebben ontdaan van de Franse officieren weten Erik en zijn bemanning van voormalige slaven uit de baai te ontsnappen. Omdat het Franse schip niet heelhuids uit de zeeslag is gekomen, kapen ze een ander Turks schip en vervolgen hun weg naar de vrijheid (Amerika). Totdat op hun nieuwe schip een brief van de Turkse sultan wordt ontdekt waarin een plan staat een grote oorlog tegen Frankrijk te ontketenen, met Engeland als bondgenoot. Erik ervaart het als zijn plicht zijn vaderland te waarschuwen voor deze grote dreiging en weet uiteindelijk zijn heftig protesterende bemanning rechtsomkeert te laten maken. Door Eriks waarschuwing zien Engeland en Turkije af van de oorlog, wordt de bemanning van het schip in vrijheid gesteld en wordt Erik benoemd tot officier van de Franse koning.

Motivatie verhaallijn
Erik en onder andere Baba zijn veroordeeld tot galeislaaf. Ze willen koste wat het kost ontsnappen. Ze worden geholpen door een scheepsjongen die in vorige verhalen blijkbaar een bepaald ontzag voor Erik heeft ontwikkeld. Tijdens het verhaal wordt het hoofddoel van het verkrijgen van vrijheid vervangen door het beschermen van het vaderland.

Karakters
Erik, Baba en verder:
een scheepsjongen (zonder naam), klein blank blond kereltje.
Omar-el-Hadj, Turk, korte zwarte puntbaard.

Dit is Erik's ego-album. Roodbaard is er niet en Erik heeft de absolute hoofdrol in dit verhaal, het draait om de gebeurtenissen en Erik's rol daarin. De rest is alleen aanwezig om kleine taken te vervullen en om dialoog mogelijk te maken.

Emoties
onterechte veroordeling (verontwaardiging), blijheid (dat de vijand ingesloten wordt), blijheid (met de bedachte list), angst, blijheid (als iets goed afloopt), verbazing (wanneer je onverwacht iemand tegenkomt die je kent)

Emotie eigenschappen
Met frisse tegenzin orders van de kapitein uitvoeren gebeurt na protest en daarna met gemopper (extreme uitdrukking van tegenzin: muiterij).

B Redbeard Analyses Results

This appendix contains the results of the story analyses of the Redbeard comics The results, as are the read comics and the story analyses, are in Dutch. Each item has a reference (the number of the appendix) to the review from which it is obtained. Some items occur in more than one review. In such cases only the first review in which the item is encountered will be listed. Section 3.2.2 of the thesis contains the most important and usable results translated into English.

B.1 Themes, Settings & Plot Line

Themes/plot line

- het plunderen van een schip(A.1)
- het enteren van een schip(A.4)
- een achtervolging(A.1)
- een thuishaven hebben(A.1)
- de vijandige relatie tussen piraten en kooplieden(A.1)
- de vijandige relatie tussen soldaten en piraten(A.1)
- het nemen van gijzelaars(A.1)
- het bedenken van een list(A.1)
- het plegen van sabotage(A.1)
- de aftocht dekken door verwarring te zaaien(A.1)
- het aansteken van waarschuwingsvuren(A.1)
- het nemen van risicovolle beslissingen (A.1)
- een twijfelende bemanning(A.1)
- ballast overboord gooien tijdens een achtervolging(A.2)
- het meereizen op een schip als verstekeling(A.3)
- een premie opstrijken voor een voortvluchtige(A.3)
- het uitbreken van muiterij(A.3)
- het verlaten van een schip met een sloep(A.3)
- het uitbreken van ziektes op een schip(scheurbuik)(A.3)
- het inslaan van vers voedsel en water(A.3)
- het gebruik maken van roeislaven(A.4)
- iemand bedriegen(A.4)
- iemand bedreigen(A.4)

- iemand overtuigen(A.4)
- het hebben van een schuilplaats(A.5)
- het vastzitten een onbewoond eiland(A.5)
- iets aan zien spoelen(A.5)
- het begraven van schat(A.5)
- het zoeken van een schat(A.5)
- het opsteken van een storm(A.5)
- het maken van een vlot van wrakhout(A.5)
- de wind die gaat liggen(A.5)
- het maken van een vuur(A.5)
- het vastlopen van een schip(A.5)
- je deel voelen van een bemanning(A.5)
- het zweren van een eed(A.5)
- het uitvechten van een zeeslag(A.6)
- de verwarring tijdens zeeslag(A.6)
- het respecteren van rang op zee(A.6)
- het afschieten van een kanon(A.6)
- explosies(A.6)
- het zinken van een schip(A.6)

Settings

in de haven(A.1)	in gevangenschap op een schip(A.6)
in een inboorlingen-nederzetting(A.4)	in het ruim(A.3)
in een schuilplaats(A.5)	op een eiland(A.1)
in een sloep(A.3)	op een schip(A.1)
in een stad(A.3)	op zee(A.1)

Table 5: Settings identified in the reviewed Redbeard stories

B.2 Objects

brief(A.5)	loopplank(A.1)	slavenschip(A.4)
drijfzand(A.5)	oorlogsschip(A.6)	sloep(A.3)
kanon(A.6)	pistool(A.1)	vat (rum/buskruit)(A.1)
ketting(A.6)	roeispaan(A.6)	vijl(A.6)
kompas(A.1)	sabel(A.1)	vlot(A.5)
koopvaardijschip(A.6)	schat(A.5)	wrakhout(A.5)
kostbaarheden(A.1)	slaaf(A.6)	zandbank(A.5)

Table 6: Typical objects identified in the reviewed Redbeard stories

B.3 Characters & Personality

The following characters play an important enough part in the story to have their personality analysed:

- Roodbaard (lang rood haar in een vlecht, rode baard en ooglapje) - onverschrokken, doortastend, spaart niemand, valt niet mee te onderhandelen, duldt geen tegenspraak(A.1) zonder mededogen, waardering voor moed(A.2) meedogenloos, gewetenloos, niet bang (fearless)(A.5)
- Erik (wit/blond lang haar in een vlecht)
  vriendelijk, sluw, gewetensvol, niet bloeddorstig(A.2) trouw aan zijn principes en aan zijn vader(A.3) dapper, intelligent(A.5)
- Driepoot (klein oud mannetje met grijs haar in een vlecht, houten been)
  pessimistisch, wanhopig, voorzichtig, wantrouwend(A.5)
- Stark le Noir (zwart haar, korte zwarte puntbaard)
  meedogenloos, vol list en bedrog(A.5)
- Don Enrique (prototypische rijkaard)
  verwaand, laf(A.1)
- Omar-el-Hadj ('de beroemde Corsicaanse barbaar') -
  listig, gewelddadig, genadeloos(A.6)
- Kolibango (koning van de inboorlingen)
  nobel(A.4)
- Typische bad guy (muiter, slavenhandelaar)
  wreed, gemeen en hebzuchtig(A.3)

The above results in the following personality traits:

B.4 Interests & Motivations

dapper(A.3)	koppig(A.1)	trouw(A.3)
doortastend(A.1)	laf(A.1)	niet mee te onderhandelen(A.1)
gemeen(A.3)	listig(A.5)	verwaand(A.1)
genadeloos(A.6)	loyaal(A.5)	voorzichtig(A.5)
gewelddadig(A.6)	meedogenloos(A.1)	vriendelijk(A.2)
gewetenloos(A.5)	nobel(A.4)	wanhopig(A.5)
hebzuchtig(A.3)	onverschrokken(A.1)	wantrouwig(A.5)
impulsief(A.1)	pessimistisch(A.5)	wreed(A.3)
integer(A.2)	opportunistisch(A.3)	sluw(A.2)
intelligent(A.5)		

Table 7: Personality traits identified in the reviewed Redbeard stories

affectie (jegens persoon)(A.1)	informatie inwinnen(A.5)
behoedzaamheid(A.5)	liefde voor iemand(A.2)
bij iemand in het krijt staan(A.4)	loyaliteit(A.3)
educatie(A.1)	opvolging(A.1)
een gezworen eed(A.6)	overleven/gezondheid(A.5)
een schuld vereffenen(A.5)	patriotisme(A.6)
eer(A.3)	plicht(A.6)
familie(A.3)	trots(A.3)
haat (jegens maatschappij)(A.3)	trouw(A.6)
haat (jegens persoon)(A.3)	vertrouwen(A.1)
hebzucht/rijkdom(A.3)	vrijheid(A.6)
iemand anders in leven houden/redden(A.5)	wraak(A.5)

Table 8: Interests and motivations identified in the reviewed Redbeard stories

B.5 Emotions

afschuw/afgrijzen(A.5)	opluchting(A.4)	verrassing(A.5)
angst(A.1)	trots(A.3)	vertrouwen(A.1)
blijheid(A.5)	twijfel(A.1)	wanhoop(A.5)
ergernis(A.1)	verachting(A.3)	wantrouwen(A.5)
frustratie(A.1)	verbazing(A.1)	woede (jegens omstandigheden)(A.3)
haat(A.3)	verdriet(A.4)	woede (jegens persoon)(A.3)
hoop(A.5)	vernedering(A.1)	wraakzucht(A.5)
onmacht(A.6)	verontwaardiging(A.6)	zelfingenomenheid(A.5)

Table 9: Emotion words identified in the reviewed Redbeard stories

C Sequence Diagram

This sequence diagram (figure 19 shows the interaction between Java and Prolog during motivational goal management and which methods and predicates are involved.

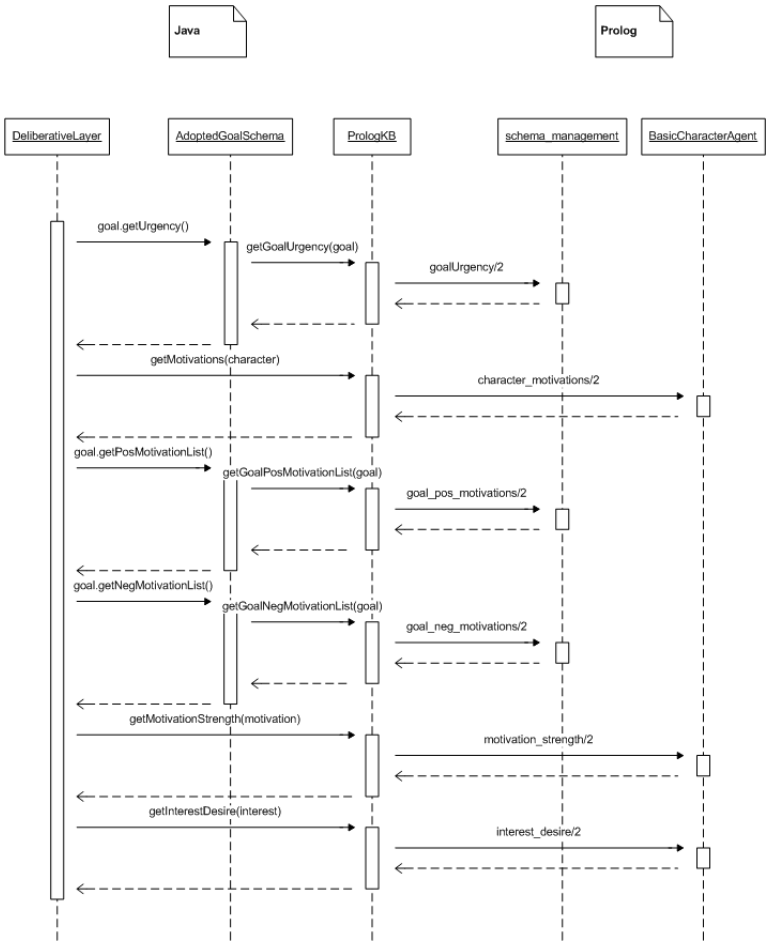


Figure 19: The dataflow between Java and Prolog during motivational goal management

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