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Linear Interactive Storytelling

by

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Declaration of Authorship

I hereby declare that this thesis has been written solely by me. All sources have been correctly referenced in text and bibliography.

Eigenständigkeitserklärung

Hiermit erkläre ich, dass ich die vorliegende Masterarbeit eigenständig und ohne unzulässige fremde Hilfe angefertigt habe. Alle verwendeten Quellen und Hilfsmittel sind angegeben.

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Abstract

Linear stories in interactive storytelling systems are commonly seen as a flaw, because they limit the freedom of the users and force them into one direction. But what if this direction happens to coincide with what the users were going to do in the first place? There would be no difference in the experience to the first run of a non-linear story.

It should be possible to write such a coinciding linear story. This thesis shows several psychological concepts which help to predict and influence the behavior of users, so that a matching linear story can be authored.

Since even the best psychological models cannot predict human behavior with absolute certainty, there is also the need to think about possible deviations. An analysis of various interactive storytelling systems shows promising strategies which can be useful for linear interactive storytelling, although the perfect framework currently does not exist. Fortunately, complex approaches are not absolutely necessary, as demonstrated by a simple exception strategy.

Keywords: Interactive Storytelling, Authoring, Linearity, Psychology, Behavior, Expectancies, Schemas, Action Identification, Priming, Wayfinding, Influence, Guidance, Drama Management

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1 Introduction

The history of interactive story telling on computers spans more than three decades. It has been commercialized in adventure games, undergone scientific research and spawned a subculture-like movement of "interactive fiction"[1].

Two directions dominate the current works in the field:

- *linear stories in game-like environments*
  Usually called "adventures" and found in a commercial environment.
- *experimental interactive drama*
  Primarily found in research projects and rarely available to the public.

The first kind uses stories which are basically linear, but take place in a world which the user can navigate in. Typically, the user has to solve problems or "puzzles" to let the story progress further. Other game genres make use of stories as well. For example, in action games story is progressed after a level has been won, in strategy games after a battle has been won[2]. While this has resulted in a large number of great stories and games, it generally has one downside: Dramaturgy suffers. Stories are interrupted by long processes of problem solving or other gaming activity which break the dramatic tension.
Scientific projects focus more on techniques to create truly non-linear stories which the user can heavily influence. Being an incredibly difficult task, not much breakthroughs have been made yet. The probably only convincing and dramaturgically compelling non-linear story so far is Façade by Michael Mateas and Andrew Stern (see chapter 3.1).

I want to follow a different approach, which has not gained much attention yet: Telling a linear yet interactive story. The structure of the story is linear – there are no multiple endings, no

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[1] *Interactive fiction* refers to what formerly was known as text adventures – adventure games which do not have a graphical presentation, but are solely based on text. Users control the adventure with textual commands and the events are presented as .text as well. For an extensive discussion of interactive fiction, see Montfort 2003.

[2] See Adams / Rollings 2007 p.205-208 fore an overview of ways to advance the plot in games.

diverting paths and basically no choice. The world in which this story is told is interactive – a simulated environment in which the user can move freely. I want to let the user interactively experience the story, but find ways to craft the plot in such a way that there is no choice which could derail the linear story. The user is part of the story, but the dramatic events flow in such clearness that the user won't decide to take a different path in the first place. This way, the dramaturgy is not broken although there is no real choice.

For example, if the evil villain threatens to kill hostages if the user does not retreat immediately, the user will most likely comply and retreat. It is an interactive action and the user chose this path, but it is nevertheless linear, because there is no other way.

This should create a story with the dramatic quality of well-crafted linear stories and the immersive quality of interactive stories. The goal is immersion[3], not influence.

Of course, behavior of human beings can't be predicted or provoked in full detail. There will be moments where no full linearity can be achieved. To deal with these moments, there should be a "low level non-linearity" which guides the user back to the linear storyline. In the former example, someone might think that the villain is bluffing and decide not to retreat. The story might then change a little and let the villain kill one hostage. Afterwards, the user would see no point in letting him kill more hostages and retreat, which ultimately leads to the same story path again.

Also, it will most likely be necessary to include optional story parts which make sure that the story keeps flowing. For example, if the user decides at some point to do nothing and wait, the

[3] My use of the term immersion follows the common use in many publications about interactive drama, literature and games (for example Ryan 2001, p.81-82; Adams 2008, p.29-30). I understand immersion as the emotional state of feeling like being part of an experience, in this case a story. This concept overlaps with notions of presence, especially presence as transportation and the psychological aspect of immersive presence. (cf. Lobard / Ditton 1997)

Immersion is also sometimes used when referring to technical, sensory immersion, mainly in the context of virtual and augmented reality applications. However, in this thesis, immersion refers to the emotional immersion and not the sensory immersion.

dramatic tension would eventually break. If possible, the system should then provide an additional incentive to keep the user going.

This thesis will describe ways in which such a linear story can be authored. It will also describe strategies how the inevitable small deviations can be handled. This thesis will *not* present an implemented prototype – the focus lies on the concepts.

1.1 User Cooperation

This kind of interactivity requires a certain commitment to the story from the user. If she[4] acts "out of character" to test the system – for example by inactively letting the villain kill every single hostage – she will find the boundaries very quickly. This is not a project to demonstrate advanced artificial intelligence, though. It is merely a concept to let people experience a story. If people decide to work against the story, there is no point in trying to adapt the story to it – sooner or later they will succeed, even if the story was told by a creative human being.

This is not completely unique to linear interactive storytelling, though. Each form of media requires a certain amount of cooperation by the user. Most games are full of limitations which openly show the boundaries of the system. Locked doors, impassable alleys and scenery items which cannot be moved are just a few examples. Generally, it usually is no secret that users cannot do everything what they want. Still, the experience is convincing enough that players allow themselves to ignore these obvious limitation, reduce their skepticism and just accept the presented world as it is meant to be – an effect often called suspension of disbelief (c.f. Coleridge 1817, chapter XIV / p.6; Teixeira / Pimentel 1993, p.15; Perlin 2004, p.12).

This cooperation of the recipient exists not only in games. The term suspension of disbelief has its origin in poetry and Andrew Glassner (2004, p.118-123) describes a very similar requirement for user cooperation in the context of stories, called the story contract: The author is responsible for the psychological integrity of the main characters (clause 1) and the sequencing and timing of major plot events (clause 2). The audience, as the other party of the contract, has to allow itself to be emotionally moved (clause 3). I would propose a forth clause for interactive stories: The user must not actively try to work against the story[5].

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[4] For the sake of readability, I will not try to use only gender-neutral pronouns. Instead, I follow the convention of Peter Weyhrauch (1997, p.2) in using feminine pronouns for the user of the experience and male pronouns for the creator of the story.

[5] Just to be clear: This does not mean that the user is responsible for behaving like the author wants. It is the author's responsibility to create a story which won't bring the desire to deviate in the first place. It only means that users should not try to actively sabotage the experience by searching for limitations.

After all, it comes down to expectations. If users expect to experience an interactive story where they can do whatever they want, they will inevitably test this promise and will equally inevitably be disappointed when they found the boundaries very quickly. If they are honestly told that such a project is not meant to replace true non-linearity, their expectations will be different and they won't become frustrated if they discover that the story can't be changed.

1.2 Why linear?

> "Plot is the action of moving forward. It is this movement forward that takes the audience through moments of change, i.e. the plot points. There is no reason to believe that the plot need be scrambled to allow for interactivity. There is a great deal of freedom in the process of narration that can be exploited without it being necessary to make the plot non-linear." (Galyean 1995, p. 60)

Without even questioning the whether non-linearity has a point at all, I have several reasons for following a linear approach to interactive storytelling.

Often, interactive stories are created to give the user more influence on the progress of the story. Striving for agency (cf. Murray 1998, p. 126) power is diverted from the author to the user. Some have even called the user a co-author of an interactive story (e.g. Tanenbaum 2007; Lindley 2005 p.168).

This leads to a difficult question: How much power should a user have over the story?

Creating a dramaturgically compelling story is a difficult task. Authors spend a lot of time constructing their plot. The process usually involves quite a lot of rewriting and restructuring.

While the user is influencing the story, there is a high chance that not much attention is used on caring about dramaturgy. After all, this would require a kind of thinking that contradicts the goal of immersion. No protagonist in a conflict would think about which actions would lead to the best dramaturgy - she cares only about how to solve this conflict.

If one co-author does not or little care about the dramaturgy of a story, there is a huge potential for a breakdown of dramatic tension. Depending on the level of power over the story, the user can more or less destroy it.

> "Every choice given to the user constitutes a potential threat to the global design, and consequently to the quality of his own experience." (Ryan 2001, p.246)

Just imagine what happens to the story if the hero decides to wait. Or searches in each drawer for clues. Or maws the lawn. The tension breaks and although the user brought this on herself, her experience will suffer. The user might even avoid the conflict in the exposition of the story – the dramaturgy would stop before it had even started. Just imagine James Bond killing the super villain with a lucky shot in the introduction…

In a compelling interactive story, the recipient must not have enough power to destroy the dramaturgy (at least not easily). Either the author must limit the influence that the user can have on the story, or the interactive system must have a good automatism to adapt the story accordingly. And this is the tricky part.

There are two fundamental approaches to adapting a story to *every* possible user action: Either author every possible development in advance, or generate an adapted story on the fly when it becomes necessary.

The first approach can be considered impossible. There are too many ways in which a story can develop if the user has full control. The complexity increases exponentially with the length of the story[6]. To illustrate this point, I'll bring up some simplifications: User actions are restricted to discrete decision points and at each point, the user has only two choices[7]. If the story is five steps long, an author would already have to write 32 different stories. Ten would require 1024 stories. 15 steps equal 32'768 stories to be authored. Since we started with extreme simplifications the reality would be even worse.

The alternative is to computationally create an adequate story on the fly. Unfortunately, this requires nothing less than an artificial intelligence which is superior to human intelligence. The system would have to be creative enough to create compelling stories. It would require a vast knowledge of the world in which the story is happening, because the user might decide to travel to all sorts of places (a problem especially challenging in story worlds with advanced transportation systems). The system would also have to do all this really really fast. A human being could not master this, because human creativity would be too slow in many cases. Research in artificial intelligence is currently not even close to accomplishing such a superior artificial creativity.

[6] A problem also known as *combinatorial explosion*. (cf. Adams / Rollings 2007, p.199)

[7] This, in effect, represents a classic branching structure.

Obviously, the requirement to come up with a compelling adaptation to absolutely every possible user action is a bit extreme. There are numerous ways to introduce simplifications. Authors can try to re-unite formerly separated story paths[8] or just not consider options which are too unlikely to be really chosen by users. The repertoire of locations can be limited. Automatic systems can try to organize human-authored content dynamically to mask their lack of creativity. Still, each of these strategies is one step away from full non-linearity and towards linearity.

Limiting the user's influence is tricky as well. It is very easy to destroy the immersion and let the interactive story degrade to something which is perceived as being pseudo-interactive. Adventure games are a classic example of this problem. Players frequently end up just trying to pick up any item, combining everything with everything else, and usually just getting the response that this won't work.

From an artistic point of view, non-linear story also make it difficult to transport a message. Many authors are not only interested in creating an entertaining story; they also want to convey a message that is important for them. Doing this in a non-linear story can be hard or even impossible. The many variations in the plot and sometimes quite complex interdependencies make it hard enough to tell even a coherent story, let alone one with the desired message.

Additionally, it is not quite clear what effect true non-linearity has on the recipients of such stories. Many practitioners have the opinion that users will want to experience every possible outcome of a non-linear story (e.g. Adams 2004; Short 2000) Emily Short, author of the non-linear interactive fiction Galatea, reported that many users worriedly asked if they really got all possible endings. Reportedly, they also were not comforted by answers like "No, but it doesn't matter". (cf. Short 2000) An early experiment in non-linear interactive drama came to the opposite result. Margaret Kelso, Peter Weyhrauch and Joseph Bates (1993) created an interactive story, using not computers but real actors on a stage and a human director. Participants of the experiment showed no increased desire for replays. Since the experiment only covered two subjects, it can hardly be called hard evidence, though.

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[8] An approach also known as foldback scheme (cf. Crawford 2005, p.126-129) or foldback story (cf. Adams / Rollings 2007, p.200-202)

Even without this problem, authoring interactive drama is very hard for authors. In most systems, the story is authored in form of programming code. This means that either the author has to be a programmer, or that he can somehow write a non-linear story in a non-code form which a programmer can later implement. Authoring and programming are two very special skills which are only mastered by a limited number of people. The intersection of those skill sets is probably even more limited, making the number of possible authors very small. Maybe this problem will be solved in future systems, though. Research on authoring environments for non-linear storytelling systems is currently in progress (see for example Skorupski et al. 2007; Medler / Magerko 2006; Spierling / Weiß / Müller 2006; Barrenho et al. 2006; Sauer et al. 2006; Iurgel 2004; Donikian / Portugal 2004)

The sheer effort to create a non-linear story is much higher as well. The amount of material which has to be written and produced is orders of magnitudes larger than for linear stories. For example, the content for the highly praised interactive drama Façade took three person-years to author (cf. Mateas / Stern 2005, p. 7) – and plays out as approximately 15 minutes of drama. Considering that each user will only see a fraction of this material, non-linear stories generally have a bit of an efficiency problem.

I hope that linear interactive storytelling will avoid these drawbacks of non-linear stories while keeping its advantage of heightened immersion.

1.2.1 Possible Spin-Offs / Byproducts

Besides my own goal of creating fully linear interactive stories, the findings of this thesis have also potential relevance for other projects.

For example, the idea for this thesis originated in the plan to build an interactive installation in which visitors can experience a story. Since physical installations are even harder to adapt to a changing story than computer-based interactive stories, a method was needed to keep deviations to a minimum.

Linear strategies can also be of use for non-linear approaches. As already mentioned, each simplification in non-linear systems is essentially one step towards linearity. Seen from another point of view, each bit of added linearity means one step towards reduced complexity. Therefore, linear strategies can support a manageable complexity in non-linear systems.

Another possible field of application is the gaming domain. Many games already include story elements, but usually the lack of influence is painfully obvious for the players. Linear strategies could help to integrate stories and games more smoothly.

Strategies from linear interactive storytelling could even be useful for a hypothetical fully non-linear storytelling system, should it ever exist. A superhuman creativity needs strategies to guide users towards a planned outcome, too. After all, even a non-linear story needs to come to an end eventually.

1.3 This is not a game

I do not consider linear interactive storytelling a sub-genre of gaming. It can easily be held for one, because games and interactive story systems often share common technologies. Many prototypes have been implemented using gaming technology. Also, gaming vocabulary has entered many theoretical works about interactive storytelling. For example, many papers call the user of such an experience "player".

Nevertheless, games – as I understand them – are something different. They are usually focused on competitive activities. Many activities are even quite repetitive, like killing one monster after the other. In games, this repetition does not really pose a problem. Mastering the skills necessary to play a game well, even through repetition, is part of the experience. Even in the border-area between games and storytelling, in the genre of adventure games, the focus usually lies on the mental challenge of solving puzzles.

Unfortunately, there is no commonly accepted definition of "game". Jesper Juul (2003) compared many existing definitions and proposed the following one:

> "A game is a rule-based formal system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels attached to the outcome, and the consequences of the activity are optional and negotiable."

Following this definition, a linear interactive story would not be a game because it has neither a variable nor a quantifiable outcome.

Another exemplary definition is

> "A game is a goal-directed and competitive activity conducted within a framework of agreed rules." (Lindley 2005, p. 174)

In this case, interactive dramas would lack the competition.

An in-depth discussion of the story vs. game debate would be outside the scope of this thesis[9], but considerations about scientific definitions taken aside, I think it is especially important not to actually call the final product a game. If the user thinks she is playing a game, the use of this term alone will change her current mindset. This will also influence her decisions and behavior in the story. If someone approaches an interactive story with a competitive mindset, for example, she might want to save the game at certain points, so that she can jump back to these saved points if she felt her performance insufficient. A need to "win" arises, to become better. The user becomes less immersed into the story and is more conscious of the system. This kind of thinking opposes the goal of immersion; therefore an interactive linear story should not be presented to the user as a game.

I also believe that this mindset can influence the authoring process. Therefore, I will use neither the term "game" for the concepts that are proposed in this thesis, nor the term "player" for the user of it.

[9] See Schneider 2008 for a more extensive overview and a concept how to combine linear stories and game elements.

1.4 Approaching Linear Interactive Storytelling / The Two Parts

My approach to linear interactive storytelling consists of two basic parts:

At first, the author has to create a linear story. This story should be crafted in a smart way which motivates the user to automatically act according to the planned plot progression.

Secondly, there will be a need to adapt the story a little in case that the first strategy fails. Human behavior cannot be predicted or controlled with certainty. It is very likely that there will be slight deviations from the planned plot in each story. This is the point where even linear interactive storytelling should introduce a little non-linearity. This does not mean large-scale adaptations of the whole story, but little changes or hints to guide the user back to the desired path.

The next two chapters will discuss these two basic strategies. The last chapter will show how the findings can be put to use.

2 Creating a Linear Story

Ideally a story for linear interactive storytelling is crafted in such a smart way, that the interactor does not even try to deviate from the planned progression of the story.

This chapter discusses different methods to create such a story. It takes a look at the different story schemes which are used by script writers. It also takes a look at psychological factors that might help to guide the experience.

One thing should be kept in mind for all strategies discussed in this chapter: There is no way to absolutely control or predict the behavior of a human being. Some strategies are more effective than others, but none will give the author certainty. Everything that follows is merely meant to increase the chances of a matching behavior.

Please also note that this chapter solely focuses on aspects relating to linearity. This does not mean that traditional storytelling techniques are irrelevant. On the contrary, general storytelling skills are vital for creating a linear interactive story, because just like traditional stories it should be well-written and generally compelling. It would be outside the scope of this thesis, to include everything that has been written about non-interactive storytelling, though. For more information about non-interactive storytelling, please refer to the common literature (for example McKee 1999; Egri 1946; Field 1979; Cowgill 1997; Seger 1990; Freytag 1863; Glassner 2004 p.35-123).

2.1 Psychological Schemas

Schemas do not only appear in movie scripts or folk tales. Research in social cognition discovered that human beings employ schemas[10] to quickly recognize and process reality.

> "A schema may be defined as a cognitive structure that represents knowledge about a concept or type of stimulus, including its attributes and the relations among these attributes […]." (Fiske / Taylor 1991, p. 98)

Schemas are built over time and are therefore based on prior knowledge. They are generally considered as a way by which human beings simplify reality and store information in a more abstract and generic way rather than the pure raw data of perception. This is also called top-down, conceptionally driven, or theory driven processing. The opposite would be bottom-up or data-driven, and based on the processing of all perceived information.

Using schemas, people can process information more quickly. They do not need to process all information, but only need to recognize the information of the schema and the information relevant to this schema. When people perceive something through a schema, they often do not perceive details, sometimes even important details. In extreme cases, even details that would contradict the schema are ignored. On the other hand, schemas allow one to fill in missing details. (cf. Fiske / Taylor 1991, p.98; Carlston / Smith 1996, p. 195-196)

This inference of details can be attributed to what some researchers call the slot structure of schemas:

> "Schemas represent categorical knowledge according to a slot structure, in which slots specify values of various attributes that members of a category possess." (Anderson 2005, p.158)

For example, the schema representation of a house would have attributes or slots like shape, size, or materials. Each slot has a default value which we have come to learn. For example, the shape of a house is usually rectilinear and materials are typically wood, brick or stone. These

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[10] Sometimes also referred to as "frames" (e.g. Barsalou 1992, p.158)

default values are not mandatory; they can be overwritten by reality, for example when a house has a circular shape. These default values are used to infer information about an object which has not been perceived – unless they are explicitly contradicted. (cf. Anderson 2005, p.157-159)

Susan Fiske and Shelley Taylor (1991, p.117-120) list several different types of schemas, but do not claim this list to be exhaustive:

- *Person schemas*
  These schemas are about the understanding of the psychology of particular individuals. They mainly focus on traits and goals.
- *Self-schemas*
  Similar to person schemas, self-schemas describe conceptions about oneself. This also suggests that information processing related to ourselves is influenced by generic self-knowledge.
- *Role schemas*
  Social roles are associated with a set of behaviors which are considered appropriate for that specific role. A role schema organizes the knowledge about these behaviors.
- *Event schemas or scripts*
  For well-known situations we develop schemas about appropriate sequences of events in these situations. Scripts are also discussed in detail in chapter 2.2.
- *Content-free schemas*
  Not all schemas contain rich information about the elements involved. Content-free schemas merely describe the links among elements. The mathematic concept of transitivity is one example for such a content-free schema.
- *Place schemas*
  Not being included – but mentioned - in the original list of Susan Fiske and Shelley Taylor, this type of schema describes concepts about well known locations. (see also Brewer / Treyens 1981)

As already mentioned, this list is not exhaustive. There are also alternative typologies, for example described by Reid Hastie (1981).

2.1.1 Application

For creating an interactive linear story, schemas can be quite interesting. If the story manages to trigger a schema, the user is very likely to act in a way which fits this schema. If the user is pursuing a specific goal, schemas can help her to achieve that goal:

> "To put it bluntly, if you know what to expect, then you know what to do to try to get what you want." (Fiske / Taylor 1991, p.155)

Not all schemas are equally useful. The probably most exciting type of schema are event schemas or scripts. These are discussed in their very own chapter. But other schemas can be useful as well.

Role schemas are important for the characters of the story. If it is desired to make the behavior of characters predictable, they can be constructed to match a role schema. This would be basically the same as creating stereotypes, which can be viewed as a special type of role schema (cf. Fiske / Taylor 1991, p. 119).

Place schemas can be a great help as well. New locations usually let the user explore them to get to know them. From a dramatic point of view, the process of exploring can easily drain the tension off a plot. If a location matches a schema, the user intuitively knows a lot about the place and the need to explore is reduced. Also, unlike role schemas, place schemas do not have as easily a negative impact on the perceived story quality. Places are not easily criticized for being schematic neither in fictional entertainment, nor in real life. Nobody complains about a train station being too much like a standard train station. Neither do people complain about fictional stories taking place in such standard locations[11].

Generally, schemas should be used with great care. Many common stories suffer from overly schematic plots or extremely stereotypical characters. It is necessary to find the right balance

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[11] Still, people do give positive credit for unusual settings.

between schematic plots and characters on the one hand and interesting developments on the other hand.

The real art in using schemas for interactive linear storytelling lies in creating plots which are schematic on the one side, but contain unpredicted developments which nevertheless do not throw the user off the story track.

2.1.2 Triggering schemas

Just because information is presented in a way that fits a schema, people do not necessarily process this information using a schema. Whether people employ schemas or not largely depends on the circumstances. So how can a story foster schema use?

Generally, people tend not to use schemas when the cost of being wrong is very high. In situations where accuracy is crucial, schemas are not very reliable and therefore data-driven processing is preferred. On the other hand, if the cost of being indecisive is very high, data-driven processing is too slow and schemas tend to be preferred. (Fiske / Taylor 1991, p.164)

To increase the chance of active schemas in the story, it should therefore include a high cost of indecisiveness and not a high cost of being wrong. A murder mystery, for example, would be less suited to trigger schemas, because it focuses more on being right (finding the murderer) than acting fast.

Susan Fiske and Shelley Taylor (1991, p.161-162) mention several factors which increase the cost of indecisiveness:

- *Time pressure*
  A theory is that people resort to schema-based judgment under time pressure, because the data-based processes simply take too much time.

- *Self-esteem threats*
  This can go in both ways. Fear of public humiliation can cause people to be more careful and therefore more data-driven. On the other hand, once the self-esteem has been damaged, people become less cautious:
  "[…] when ones self-esteem is publicly undermined, one may utilize schematic judgments in order to bolster one's image." (Fiske / Taylor 1991, p.161)

- *Communication sets*
  If people expect having to communicate information to other people, they form more polarized, fixed and often more category-oriented impressions than people who only expect to receive information. Communicators also have a tendency to use stereotypical information more often than receivers.

- *Narrative mode*
  When people want to tell a good story, they operate in a narrative mode. This is the same mode as clinical judgments which should demonstrate emotional sensitivity and intuitive understanding. In this mode, people use more prior schemas in contrast to people in a paradigmatic mode.

Of these factors, time pressure seems to be the most important one which can be facilitated in interactive drama. One can easily imagine scenes where time is a crucial element, the ticking time bomb being only the most obvious example. Interestingly, this coincides with classic dramatic flow where the tension increases towards the end. In the beginning, the story speed is still slow, and non-schematic behavior is adequate. Time pressures in storylines tend to happen at climaxes, where schematic behavior is more desirable to keep the flow.

Self-esteem threats, on the other hand, are hard if not impossible to implement. Since interactive storytelling as proposed in this work is a single user experience, one can hardly be "publicly undermined". This factor might become interesting, though, if future projects start to explore possibilities of multi-user interactive storytelling.

Narrative mode and communication sets are also difficult to use. It might be possible to construct a story which requires the user to tell a story herself, or generally communicate information. Current technological limitations in natural language processing will make it difficult to embed this in a meaningful way, though.

It is also assumed that a positive mood supports heuristic processing modes. (cf. Hänze / Meyer 1998; Bless et al. 1996; Schwarz / Clore 1996, p.446-447) Therefore, positive stories could be more beneficial to the use of schemas.

The conditions under which people rely more on expectancies (see chapter 2.6) are also very similar to those under which they use schemas (time pressure and not accurate data processing for example). It is therefore very likely that multi-tasking and threats in general also support the use of schemas.

Situations with a need for high accuracy might also lessen the priming effect (cf. Higgins 1996, p.152). Priming, the prior exposition to key ideas, can increase the accessibility of schemas. And more accessible schemas are more likely to be activated. (cf. Fiske / Taylor 1991, p.145-146) For a more detailed discussion of priming, see chapter 2.5.

Another important – but not controllable – factor could be the age of the user. There has been evidence that older adults rely more heavily on schemas when remembering. (cf. Mather / Johnson 2003, p. 171) This could mean that older people also engage more in schema-based behavior, although this has not yet been studied.

Physiological arousal does also increase schematic processing (cf. Kim / Baron 1988), although this is hardly[12] relevant for linear interactive storytelling.

[12] It might become interesting in environments which can indeed become physically exhausting. Games have already employed interface elements which require a notable physical activity (for example the famous dancing pads of Dance Dance Revolution). One could imagine elaborate attempts in the storytelling domain which include physical activity, for example using mixed reality technology.

2.2 Scripts

> "A script is a structure that describes appropriate sequences of events in a particular context." (Schank / Abelson 1977, p.41)

Scripts[13] [14] are a concept that tries to describe how we deal with sequences of events in a schematic way. One famous example is the restaurant script. When we visit a restaurant, we expect a more or less detailed series of events. This series of events includes taking place at a table, studying the menu, ordering the meal, eating the food, etc.

The script structure is thought to be divided into higher-level events called scenes (e.g. "ordering") which contain several lower-level actions (e.g. "signaling the waiter", "telling the waiter what food one wants", etc). (cf. Schank / Abelson 1977, p.41-46) Bower, Black and Turner (1979, p.186) describe scripts as an organized tree of events which can be decomposed into hierarchy of subactions.

As already mentioned, scripts are also referred to as event schemas (cf. Fiske / Taylor 1991, p.119). Similar to other schemas, scripts help us to process information quicker and with less mental effort. In the above example, we do not need to wonder what to do next once we took place at a table. We have done this often enough to form a cognitive structure, a script, which tells us what typically happens next.

We can infer information from a script which we did not really perceive or concluded in reality. Besides knowing effortlessly what to do next this also helps organizing our memory. Actions which are typical for a scripted activity are remembered better in the long term[15]. (cf.

[13] Other used terms are *event schema* (Fiske / Taylor 1991, p.119), *event concept* (cf. Anderson 2005, p.163) or *brain script* (see Mikunda 2005).

[14] Please not that these are not the same as *life scripts*, a term used in psychotherapy and transactional analysis. These are though to be larger structures controlling one's life over years and not representations of short-time events that would be of interest for this thesis. (cf. Berne 1961; Steiner 1974)

[15] In the short term, atypical actions are remembered better than typical actions, but atypical actions are faster forgotten. (Graesser et al. 1980)

Graesser et al. 1980). Sometimes this can go as far as remembering things which did not happen in reality, but should have happened according to the script. (cf. Abelson 1981, p.717; Bower / Black / Turner 1979, p.196) Even behavior can be changed as if certain scripted events had happened, although they have not. (cf. Bargh 1996, p.179; Langer / Blank / Chanowitz 1987)

This also applies to the order of events in scripts. Robert Abelson (1981, p.717) distinguishes between weak scripts and strong scripts. Weak scripts only contain a bundle of anticipated events without any particular ordering. Strong scripts, on the other hand, also contain associations between prior and consequent events. As with other schematic features, the order of events tends to be remembered in a more script-conformant way than happened in reality. If the order deviates for an event series in reality, the displaced events have a tendency to regress towards their usual positions in memory. (cf. Abelson 1981, p.718; Bower / Black / Turner 1979)

So basically scripts are a version of schemas which are specialized to patterns of events or behaviors. This makes them interesting for linear interactive storytelling. Most of what I wrote about schemas in general also applies to scripts. If people are in an automated processing mode they are more likely to act according to the script and less likely to deviate from the planned plot progression. So if a linear story includes the events of a script, the chances are good that the user will automatically follow this linear story.

Actually, there already exists one example where this technique has been used. The interactive fiction *Photopia*[16], written by Adam Cadre, includes one scene where the user discovers her daughter floating lifeless in a swimming pool. The script is simple and very short but effective: Upon discovering a drowning person, rescue her from the water, and then revive her. It is extremely unlikely that a user will instead decide to explore the area instead of fishing the child out of the pool.

Scripts do not necessarily represent only one linear progression of events, though. Robert Abelson (1981, p.723-724) lists eight factors that embody script variations:

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16 http://adamcadre.ac/if.html (17.4.2008)

- *Equifinal actions*
  Several different actions can lead to the same result. It does not matter whether one asks for the menu in a restaurant by verbally asking for it or giving a sign to the waiter.

- *Variables*
  Some objects or persons can be different in different script episodes (or instances, using artificial intelligence jargon). Though these objects can be different in each script instance, they remain constant throughout this instance. So if in one instance of the restaurant script, "fish" is used during ordering for the variable "food", it won't suddenly change to "chocolate" during the eating event (unless an explanation is provided).

- *Paths*
  Scripts can offer branching points where alternative behavior can be used. For example, one can skip signaling the waiter for the menu if the menu is already on the table.

- *Scene selection*
  This factor is mainly important for weak scripts where events aren't strictly ordered. Strong scripts do not allow for much variation in the scene ordering.

- *Tracks*
  Different script variants which each have characteristic paths, scene selections and props are called tracks. For the restaurant script, there can be a fast-food track, a standard-restaurant track, a noble restaurant track and probably more.

- *Interferences*
  Scripts can be disturbed by interferences. Schank and Abelson (1977) distinguish between two types of script interferences: Obstacles and errors. Obstacles remove a precondition for an event in a script, so that this event can't happen. For example, the waiter might be out of menu cards so he can't deliver a menu. Errors represent the wrongful completion of an event. For example, the waiter might deliver only the wine menu.

If someone has enough experience with a script, alternative actions for common interferences get encoded as paths in the script.

- *Distractions*

  Events with sufficient salience can interrupt script events. Distractions in a restaurant script could be an earthquake or an important cell phone call.

- *Free behaviors*

  There are plenty of behaviors which can freely intermix with the execution of a script without disturbing it. A typical example in the restaurant script would be an ongoing conversation.

Paths are especially critical to linear interactive stories, because basically they represent a non-linear structure. Ideally, scripts for linear stories should not have any separate paths. If this is not possible it depends on the nature of the path how critical the effect on linearity really is. Some paths might represent small detours which automatically lead back to the original paths (e.g. the customer does not want to order drinks immediately after she is seated, but does so later). More tricky are paths which change the outcome of the script (e.g. the customer does not find anything eatable at the menu and leaves the restaurant hungry and in search for the next food source). Such alterations would have to be taken care of by the interactive guidance system (see chapter 3).

Equifinal actions are in themselves not bad for linearity, because they do not change the overall path of the story. It might be detrimental to the user experience, though, if some equifinal actions are technically impossible to perform, because they have not been anticipated.

Variables, interferences and distractions should not pose a problem since they fall under authorial control and therefore should not happen unexpected for the author.

Free behaviors should also be largely under authorial control (e.g. there needs to be another character for any discussion to happen). Also, they should – by definition – not interfere with the progress of the script.

2.2.1 Triggering Scripts

Being so similar to schemas, one can assume that most conditions which encourage schema use (see chapter 2.1.2) also encourage script use.

The influences of mood on automatic processing (cf. Hänze / Meyer 1998; Schwarz / Clore 1996, p.446-447) have been specifically reproduced for script usage. Happy individuals rely more on scripts than sad individuals, with neutral individuals being in between. (cf. Bless et al. 1996)

Similarly, the theory that older adults rely more on schematic knowledge than younger adults (cf. Mather / Johnson 2003, p. 171) has some script-specific support (cf. Hess 1985).

More script-specifically, Roger Schank and Robert Abelson (1977, p.46-50) think of *headers* to activate scripts. They list four basic types of headers:

- *Precondition Headers*
  This header type refers to a central precondition of the script which is mentioned in the text. For example, the character being hungry would be a precondition header for the restaurant script.
- *Instrumental Headers*
  When a context comes up which is instrumental for a script context, it is called an instrumental header. For example, if a character takes the subway to a restaurant, it is very likely that the restaurant script will be used upon arrival.
- *Locale Headers*
  Many scripts have a distinctive location at which they take place. The restaurant script is typically used at restaurants; a grocery shopping script would run in a grocery store, etc. Placing a character in such a location increases the expectations about the occurrence of such a script.

- *Internal Conceptualization Headers*
  This header type consists of events or roles from the content of a script[17]. For example, the occurrence of a waiter would be an internal conceptualization header for the restaurant script. So would be taking seat at a dining table.

Just because one of these headers is present in a story does not mean that the corresponding script is really used. It depends on the header and context how much of an indication for script usage it really is. For example, being in a restaurant (location header) is a very strong indicator for the restaurant script as opposed to just being hungry (precondition header). Still, if the character is in a restaurant but busy fighting off an alien invasion, the restaurant script will not be used. According to Schank and Abelson (1977, p.50), two header items are necessary to be certain a script has been invoked.

It should be noted that Schank and Abelson theorized about headers in the context of text comprehension and artificial intelligence – not in the context of actual behavior. It is unclear if the concept of headers can be transferred to real events instead of lines of text.

In a follow-up work, Robert Abelson doesn't even mention headers anymore. He thinks that three conditions are necessary for scripted behavior to occur: The person must have a stable representation of the script; a context which evokes the script must be presented[18]; the person must *enter* the script. (cf. Abelson 1981, p.719)

Whether the individual enters the script or not depends on an action rule which is attached to the script. According to Abelson, this is the critical condition at the gap between cognition and behavior. These decisions are likely to be made according to a policy which has been developed over experience. They are not necessarily consciously made. Abelson's example for such a policy for a script which describes going to the dentist is "If it keeps hurting for several hours, call the dentist." (Abelson 1981, p.719)

[17] Bower, Black and Turner (1979, p.183) also speculate that the mention of "main conceptualizations" should call up the script from a reader's memory.

[18] This could be interpreted as the aforementioned headers.

However, literature on these action rules is scarce. Abelson mainly refers to research about helping behavior and conformity. If one views scripts as schemas the importance of action rules becomes doubtful. One does not have rules when to apply a schema or not, so why should this be different for event schemas?

It is also assumed, that individuals are more likely to enter a script if they have done so at least once before. (cf. Abelson 1976, p.45) This would make scripts derived from experience more applicable to linear interactive storytelling than other scripts, like scripts which have been learned through media.[19]

On the other hand, learned scripts can be more exciting because people are less used to them. Trained scripts like emergency measures, for example, can be used for a much more interesting story, although they might be not as likely activated.

2.2.2 Sources for Scripts

To effectively use scripts in linear interactive storytelling, one must know appropriate scripts which are known by as many users as possible.

Unfortunately, there is no large catalogue of scripts. Adult human beings are supposed to be equipped with thousands of scripts (cf. Schank / Abelson 1977, p.68), but knowing them is largely left to the experience of the author.

Most literature only refers to the famous restaurant script which is described in detail by Roger Schank und Robert Abelson (1977, p.42-46). Other scripts are only described in part by Schank and Abelson, many even only with their name (cf. Schank / Abelson 1977, p.62,63,65).

Gordon Bower, John Black and Terrence Turner (1979, p.182) list three scripts with their most important actions: Going to a Restaurant, Attending a Lecture, Grocery Shopping and Visiting a Doctor.

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[19] This does not mean that scripts which have not been directly experienced yet, would not work at all. For example, most people would very likely engage in the script which describes the rescue of a drowning person even if they have never rescued a drowning person before. After all, every experience has to be experienced for the first time at some time.

Dennis Maciuszek (2007) extracted 23 scripts from the Winners Reel of the Cannes Lions 2004, a collection of highly praised commercials. All scripts have a petrinet illustrating the event structure, several textual descriptions and a rating of the assumed level of awareness. Please note that this script collection is based on Christian Mikunda's (2005) interpretation of the script concept ("brain scripts") which is in parts different from the common scientific theories.

Louis Zurcher (1992a, 1992b) described the staging of emotions in the context of a football game and a military reserve exercise. Though he uses terms like "scripted", there is no direct connection to the theories mentioned above. Both works don't contain clearly defined scripts and therefore should rather be considered an inspiration.

All these sources for scripts are probably not sufficient to be used in a linear interactive story. Authors will have to come up with more scripts which fit their story.

Bower, Black and Turner (1979) asked individuals to write scripts for common activities. They discovered that the exact instructions were quite critical to the success of the script writing. These are the instructions they finally used (in the case of a script for attending a lecture):

> "Write a list of actions describing what people generally do when they go to a lecture in a course. We are interested in the common actions of a routine lecture stereotype. Start the list with arriving at the lecture and end it with leaving after the lecture. Include about 20 actions or events and put them in the order in which they would occur." (Bower / Black / Turner 1979, p.180-181)

The resulting actions were rated by how often they were written by different people. The end result was a list of actions which represents the script, with the least mentioned actions discarded and the remaining rated by popularity.

While this technique seemingly gives good results, it has the drawback that it is quite work-intensive. For each script, Bower, Black and Turner asked groups of 24-37 subjects to create such lists. During authoring a story, this does not seem feasible.

Jeff Orkin and Deb Roy (2007) investigated a method to create script-like information called plan networks by automatically analyzing the behavior of thousands of online players. To do this, they created an online game called "The Restaurant Game" which recreates a typical restaurant situation (probably inspired by the restaurant script). The game was subsequently played by 7000 users. The data of 5200 game sessions was used to generate the plan network. While being an interesting approach, the scalability seems doubtful. To generate a large number of scripts this way, one would have to create several games and get a whole lot of users to play them. Again, this does not seem a feasible procedure during authoring a story.

So basically, authors are stuck with extrapolating scripts from their experience.

2.3 Attitudes

> "Attitudes are what we like and dislike, our affinities and aversions, the way we evaluate our relationship to our environment. An attitude is a disposition in the sense that it is a learned tendency to think about some object, person, or issue in a particular way." (Zimbardo / Leippe 1991, p.31)

If the attitudes of a user are known, then her behavior becomes more predictable, because attitudes can guide behavior (Fazio 1989, p.167; Breckler / Wiggins 1989, p.419; Eiser / van der Pligt 1988, p.26). This makes attitudes interesting for interactive linear dramaturgy. If the author knows how a user will behave in a specific situation, he can write the story to match this behavior so that it will not derail.

Of course, not everybody has the same set of attitudes. Attitudes can vary widely. More sophisticated systems might be able to dynamically detect attitudes by monitoring the behavior of the user[20] – but then they would have to dynamically adjust the story to make use of these insights, which would contradict the goal of this thesis.
With some common sense, it should be possible to think of attitudes that are widely shared among potential users. For example, most people have the attitude that killing someone is wrong.

Not every attitude translates equally well into behavior, though. Many attitudes cause surprisingly inconsistent behavior. There are a few indicators, which are beneficial for behavior prediction (Fiske / Taylor 1991, p.520-524):

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[20] This process would be called an implicit measurement of attitudes. Implicit measurement means that the attitudes are not directly expressed by the subject, but rather passively detected by monitoring behavior. This also influences the types of behavior that can be predicted. "Implicit attitude measures tend to predict behaviors that are spontaneous, uncontrollable, and / or not consciously controlled behaviors. Conversely, explicit attitude measures tend to predict deliberative, controlled behaviors, but do not seem to be related to unmonitored or uncontrollable behaviors." (Vargas 2004, p.279)

- *Direct experience*
  Attitudes which have formed through direct experience usually result in more predictive behavior than attitudes that are not based on direct experience.
- *Vested interest*
  If an attitude involves a person's self-interest, then the person is more likely to act according to it.
- *Being unquestioned*
  People who are induced to think about an attitude show a less consistent behavior.
- *Easy access*
  Some attitudes represent rather abstract values. In a specific situation, the "likelihood that the attitude will be activated from memory upon mere exposure to the attitude object" (Fazio 1989, p.154) might not be high enough to really influence the behavior. For example one might have the attitude that the environment should be protected, but this attitude can be on such an abstract level, that it doesn't stop one from getting a plastic bag in a shop. (see also Ajzen 1996, p. 311)
  Priming might help to increase the accessibility of attitudes. (see chapter 2.5)
- *Much information on object*
  The more information is available on the object of an attitude, the greater is the congruence between attitude and behavior.
- *Self-schema attributes*
  Attitudes which represent self-schema attributes result more likely in matching behavior.

> "Overall, attitudes that matter to a person […] show a stronger relationship to behavior than those that matter little […]. The implication for the cognition-behavior relationship more generally is that cognitions that emerge from personal rather than indirect experience, and cognitions that have implications for one's life, predict behavior better than cognitions that develop merely from mild curiosity, passing interest, or a second-hand source." (Fiske / Taylor 1991, p.524)

Behavior is also easier to predict if the attitudes are at the same abstraction level as the behavior. Very general attitudes are a weak instrument to predict concrete behaviors. (cf. Ajzen 1996, p.311-312)

On the other hand, the correlation between attitude and behavior can be easily overridden by social norms. Not every person is equally subjective to social context, though. (cf. Fiske / Taylor 1991, p.530-539)

The influence of attitudes on behavior is also not dependent on the age of the user, at least for the younger age ranges. Trafimow et al. (2002) tested the effect of attitudes on intentions [21] and found no variance over age groups from 8 to 16.

Generally, it should be noted, that even if user attitudes can be assessed correctly by the author, the behavior can still vary widely. Attitudes are no magic wand for predicting behavior. The attitude behavior correlation is believed to be about .40 (cf. Lord 2004, p.299).

[21] The study did not test actual behavior, but behavioral intentions, which is considered a feasible substitute by the authors. They also did not exclusively focus on attitudes, but also on subjective norms, which can roughly be described as social influence. There was no difference in the influence of subjective norms over age either.

2.4 Action Identification

According to the theory of action identification (cf. Vallacher / Wegner 1987), actions can be identified at high or low levels of behavior. Identifications on a higher level stand for a more abstract understanding of the actions, while lower levels stand for more specific actions. Picking up a waste paper, for example, would be a low level action identity, while cleaning up your room would be a high level action identity.

When an action is identified at a low level, it might be subject to context effects, meaning that a higher-level identity is cued, basically giving new meaning to the activity and possibly sidetracking it. Activities which are identified at higher levels are therefore more stable than those at low levels. (cf. Fiske / Taylor 1991, p. 526)

Applied to interactive storytelling, this means that users which are given a task are more likely to pursue this task smoothly, if it is identified at a higher level. If users are animated to do something at a lower level, there is a greater danger of them being sidetracked and the story derailing.

However, high level identification is not always the best way to prevent distraction. The identification level should match the difficulty of the task. “Specifically, difficult tasks should be performed best when identified in low-level terms, whereas easy tasks should be performed best when they are identified in high-level terms.” (Fiske / Taylor 1991, p.527)

2.5 Priming

Ideas that have been activated recently are more likely to be activated again during the interpretation of new information. This is commonly called *priming effect* (cf. Higgins 1996, p.134-135; Fiske / Taylor 1991, p.257).

For example, Tory Higgins, William Rholes and Carl Jones (1997) conducted a study in which the test subjects had to describe the ambiguous behavior of a fictional character as either "stubborn" or "persistent". In an earlier experiment, the researchers had found that both judgments are equally probable. Now, they had their test subjects perform another test before this characterization. Subjects were told that the tests were not related, but in the first test, they had been exposed ("primed") to either the word "stubborn", or "persistent". The group of subjects who were primed with "stubborn" was much more likely to describe the story character as stubborn as well. Likewise, those primed with "persistent" were more likely to think of the character as persistent as well.

It is not necessary to prime exactly the same word which is desired to be activated later on. It is presumed that activation spreads over associative links, so that related concepts are also more likely to be activated. (cf. Carlston / Smith 1996, p.195)

Since an increased accessibility can also lead to an increased likelihood of related behavior (cf. Carlston / Smith 1996, p.201), the priming effect is interesting for interactive linear storytelling. The effect can be used to influence the user to do the right thing next. If a story contains an ambiguous situation, prior priming can help guide the user in the right direction. It might also be possible that schemas and scripts get activated more easily if primed beforehand.

For how long a priming effect lasts, depends on the circumstances. Strong priming effects can last for more than a day. On the other hand, if the primed information competes with another accessible construct, the priming might last only for minutes or less. The effect can be increased and lasts longer if the priming is done repeatedly. (cf. Higgins 1996, p.138-139)

The time frame in which a priming is effective lessens extremely if other concepts have been primed more frequently. In this case, a more recent priming usually dominates only for about 15 seconds. After that timeframe, the more frequent priming becomes dominant. (cf. Higgins 1996, p.139; Fiske / Taylor 1991, p.265)

All those findings are based on experiments where the test subjects were not aware of being previously primed. If priming is done too blatantly, it can provoke the opposite effect. In this case, the primed person is more likely to use the information which contrasts the prime. Using the example above, subjects who would have been blatantly primed with "stubborn", so that they would have become aware of being primed, would afterwards be more likely to describe the fictional character as persistent.[22] (cf. Higgins 1996, p.143-145; Fiske / Taylor 1991, p. 260-261)

The strength of the priming effect is also dependent on the type of priming. Priming by trait words does not last as long as priming by behavioral descriptions. (cf. Higgins 1996, p.145)

[22] This is only a hypothetical example, the original experiment did not test for contrasting effects.

2.6 Expectancies

Throughout our daily life, we make all kinds of assumption how things will be in the future. This does not only include complex projections, but also very basic anticipations like that the ground won't swallow us upon the next step. In psychological literature, these assumptions are called *expectancies*:

> "Expectancies are beliefs about a future state of affairs. They are subjective probabilities linking the future with an outcome at some level of probability ranging from merely possible to virtually certain." (Olson / Roese / Zanna 1996, p.211)

Expectancies guide attention. Information which either matches or contradicts expectancies is more likely to be noticed. People are more likely to interpret information in line with their expectancies. In general, behavior of people has a tendency to be consistent with their expectancies. Expectancies can even become self-fulfilling prophecies and elicit behavior which would have not happened without the expectancy[23]. (cf. Olson / Roese / Zanna 1996, p.211; p.220-223)

Applied to interactive storytelling, this means that by influencing the expectancies of the users, their behavior can be influenced in the desired direction of the story.

Unfortunately, there has been little research in the creation of expectancies (cf. Olson / Roese / Zanna 1996, p.233), so authors of interactive linear stories will largely have to rely on their intuition in this point. However, there is some information available on other expectancy-related factors.

For example, the expectancy that one can perform a task satisfyingly can influence one's attitude towards that task positively. It can reinforce the intention to really perform this task.

[23] Some researchers even suspect that expectancies can influence memory performance, e.g. the expectancy to have a bad memory leads to lesser recall abilities and vice versa. (see van Oorsouw / Merckelbach 2007)

People who expect to succeed also tend to spend more effort on the task and be more persistent. (cf. Olson / Roese / Zanna 1996, p.219-221; Mischel / Cantor / Feldman 1996, p.337)

So if the author wants the user to perform a certain task in a story, the user should expect to succeed in that task. Unfortunately, tasks which are expected to be accomplished seldom make an interesting story. It might help though, that users are aware of being in a storyworld where other rules apply. For example, when someone sets out against an extremely superior adversary in the real world there probably won't be an expectancy to win. On the other hand, if we see the hero of a story setting out to fight a dragon armed only with a shovel, we expect that there will probably turn out to be a way for the hero to win. It is very likely that a user in an interactive storyworld will apply these same dramatic rules and expect to succeed in such difficult tasks.

Similar to schemas, expectancies have a higher chance of confirming themselves when one is in data-driven processing mode. If one is trying to build an accurate impression, evaluating available data carefully, the expectancies are also more closely inspected and the expectancy effects are lessened. In general, people rely more on expectancies when they are unable or unwilling to devote more cognitive resources to information processing. This happens under time pressure, when people are multi-tasking, under threat and sometimes even when it is not the right time of the day and their cognitive capacity is not at their full extent. (cf. Olson / Roese / Zanna 1996, p.223; p.228-229)

It is also beneficial if expectancies are confirmed. For one, this induces positive affect. It also increases the certainty of the corresponding expectancy and people are more likely to go on without paying close attention to details. Conversely, disconfirmed expectancies make people engage in more careful processing of relevant information. The expectancy becomes less certain, and the trust in one's judgment is lessened. (cf. Olson / Roese / Zanna 1996, p.226-228)

So if expectancies get confirmed in the course of the story, these expectancies are more likely to guide the user's behavior in the future. If the user has slain one dragon, she will expect to be able to do it again and it becomes more likely that she will engage in that task. Confirmed expectancies will also keep the user in the concept-driven processing mode, with the useful side-effect of increasing the effectiveness of schemas.

Therefore it has many benefits to confirm the user's expectations in an interactive linear story. Again, the downside is that it does not necessarily make an interesting story if expectations are always confirmed. Confirmations are good for the flow of the story, while disconfirmations (surprises) make it interesting.

An author should be careful which expectancies to confirm or disconfirm. It would be best to choose those expectations for surprising disconfirms which will not play an important role later on in the story. Alternatively, the disconfirmation could be so firm that it changes the expectancy so definitely, that it becomes very certain again. For example, if an ally suddenly betrays the user, the former ally could turn out to be so definitely evil that the user will expect him to behave like a villain with absolute certainty. If the betrayal is not that definite, the user might not have any clear expectancies towards him anymore[24].

[24] Of course, such unclear states can – when done well - be used for interesting dramatic developments, but this is not the point here.

2.7 Command and Influence

Authorities can guide the behavior of individuals very directly. The famous Milgram Experiment (1974) has shown that human beings are surprisingly obedient to authority. Therefore, one technique to guide a user through a linear plot is to simply include an authority in the story which instructs the user to do what she is supposed to do.

For example, if the story is set in a military environment, a superior officer could instruct the user to do something. There are also less obvious examples of authority, like the one appearing in the earlier mentioned interactive fiction Photopia: An emergency doctor instructs the user over phone how to save someone's life. In such a case, the user will most likely accept the orders of the doctor and act accordingly.

Even without authority, there are various techniques which try to persuade individuals to follow a request. Popular literature has a vast amount of works on persuasion, but several techniques have also been investigated by social scientists.

For example, low balling is a technique which exploits the desire of individuals to stay true to their commitments. At first, one is persuaded to make a commitment, based on an agreement which is favorable for the "victim". Later the deal is changed to disadvantage using some excuse. Unless the disadvantage is too great, many people will feel the need to keep their commitment, despite the changed offer. (cf. Zimbardo / Leippe 1991, p.80-81; Cialdini et al. 1978).

The most extensive research of such compliance tactics has been done by Robert Cialdini (1987; 1993). He argues that automatic processes can be exploited and used against us. Unfortunately, it would be beyond the scope of this thesis to describe Robert Cialdini's theories in detail. Instead, I resort to a list of the six basic principles which form the basis of these "weapons of influence" as Cialdini (1993) calls them:

- *Reciprocation*
  Individuals feel a strong need to repay favors of any kind – whether the favor has been given on request or not. This is exploited for example by the famous Hare

Krishna Society whose followers first give flowers to passers-by and then ask for a donation.

- *Commitment and Consistency*
  People also feel a strong need to be consistent to their commitments. Once they have committed to a position, people are more likely to comply to requests for behavior which are consistent with this position. ("low balling", described above is one famous technique of this category)

- *Social Proof*
  If other people are known to be or have been performing a behavior, we are more likely to comply with a request to the same behavior.

- *Liking*
  We are also more likely to comply with a request if we like the requester. Behind this rather obvious connection lies a whole collection of tactics aimed at making people like a requester.

- *Authority*
  As already described above, people are very likely to comply with a request if this request is coming from someone who is thought to be an authority. Cialdini also lists several techniques aimed at faking authority.

- *Scarcity*
  If something is scarce, we are suddenly much more eager to have it. This is a technique which has been (and still is being) used by countless salesmen with "limited offers".

Although Cialdini describes these principles mainly in the context of exploitive salespeople, not every application of such techniques is abusive. They are based on automatic behavior which is designed to help us make decisions more efficiently. Problematic are only the cases of harmful exploitation, as Cialdini says himself (1993, p.228):

> "Compliance professionals who play fairly by the rules of shortcut responding are not to be considered the enemy; to the contrary, they are our allies in an efficient and adaptive process of exchange. The proper targets for counteraggression

> are only those individuals who falsify, counterfeit, or misrepresent the evidence that naturally cues our shortcut responses."

Nevertheless, linear interactive stories should usually make scarce use of such techniques. If a user is told throughout the whole game what to do, the experience becomes dull. When used badly, directions by artificial characters can even be considered malevolent or restricting and trigger the opposite reaction[25].

[25] An effect called reactance, which primarily sets in when previously established freedoms are threatened. (see Brehm 1972; Eagly / Chaiken 1992, p.568-573) Of course, this opposite reaction can also be what the author intended to achieve in the first place.

2.8 Situations without Choice

While the previous chapters focused on creating situations in which the user automatically chooses the intended course of the story, there is also the option to radically bereave the user of any control.

To do this, the story has to provide a situation in which the user believably has no choice. One example would be a scene in which the user is violently robbed by a robber who is absolutely superior. There is nothing that the user can do, yet this powerlessness is exactly what the story wants to bring across.

Similarly, the user can intentionally left to be puzzled what to do next. The feeling of not knowing what to do can be desired by the author as part of the story.

Aforementioned *Photopia* includes several scenes in which the user cannot do anything at all: In one scene, the user is on the passenger seat of a driving car. The driver is heavily drunk and unresponsive. The user can't do anything to stop the car from crashing on a junction. In another scene, the user is suddenly finds herself without any bodily control – to weak to move even the smallest muscle let alone opening her eyes. After some time it becomes clear that she is awakening in a hospital after the accident. In both scenarios, the hopeless incapability is justified by the story content and used very well to convey this very feeling of being powerless.

Still, these are risky techniques because they can easily lead to user frustration, especially when used repeatedly. In small doses it can be effective, though.

2.9 Story Patterns

There exists a variety of theories which structure makes the best story, especially in film writing literature. This chapter takes a look at these structures to see if they can be used to guide a user in a linear interactive story.

2.9.1 Three- and Five-Act-Structures

One of the most famous story structures is the three act structure. It is often credited to Aristotle. In his famous book[26] Poetics, Aristotle wrote about Greek tragedy that it has to be "whole", meaning:

> "A whole is that which has a beginning, a middle, and an end. A beginning is that which does not itself follow anything by causal necessity, but after which something naturally is or comes to be. An end, on the contrary, is that which itself naturally follows some other thing, either by necessity, or as a rule, but has nothing following it. A middle is that which follows something as some other thing follows it. A well constructed plot, therefore, must neither begin nor end at haphazard, but conform to these principles." (Aristotle 300BC, Part VII)

This separation into the three[27] parts beginning, middle and end was later developed into the three act structure.

Syd Field (1979) described his three act structure in a much tighter form. He created what he called the paradigm – a three act schema for movies which even defines on which exact page of the script the key events (*plot points*, in his terminology) should occur.

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[26] It is somewhat unclear whether Poetics is really a book, or rather a transcription of his lectures by one of his students. There is even speculation that parts of Poetics were written by subsequent commentators. (cf. Wikipedia 2008; Carlson 1984, p.16) For an argument in favor of the whole-book-theory see Kommerell 1970, p.50-51.

[27] It should be noted that in the same book, Aristotle also writes "Every tragedy falls into *two* parts- Complication and Unraveling or Denouement." (Aristotle 350BC, Part XVIII, emphasis by me)

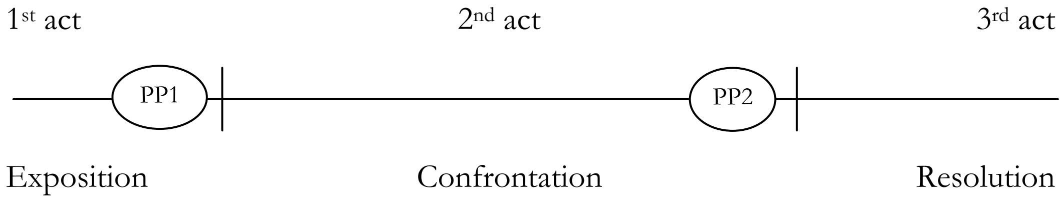

Figure 2-1: Syd Field's paradigm (cf. Field 2001, p.14)

Gustav Freytag proposed a 5-act-structure, which he visualized in form of a pyramid. The five acts are “Einleitung” [exposition], “Steigerung” [rising action], “Höhepunkt” [climax], “Fall oder Umkehr” [falling action] and “Katastrophe” [catastrophe]. The exposition ends with an inciting moment (“erregendes Moment”) which brings the story in motion and leads to the rising action. The climax is ended by the tragic moment (“tragisches Moment”) which leads to the falling action. A third key moment, the moment of final tension (“Moment der letzten Spannung“) may appear between falling action and catastrophe. (cf. Freytag 1863, p.100-120)

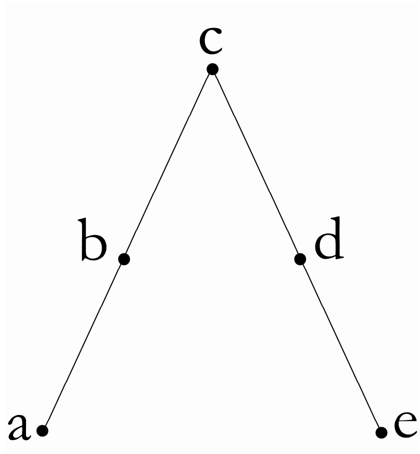

Figure 2-2: Freytag’s Triangle (c.f. Freytag 1863, p.100)

This triangle already bears some similarity to modern visualizations of dramatic flow – and probably inspired many of them. Figure 2-3 follows the presentation of Linda Seger (1987, p.5). It is quite similar to an illustration which Brenda Laurel called “a ‘modern’ Freytag-style graph” (Laurel 1993, p.85).

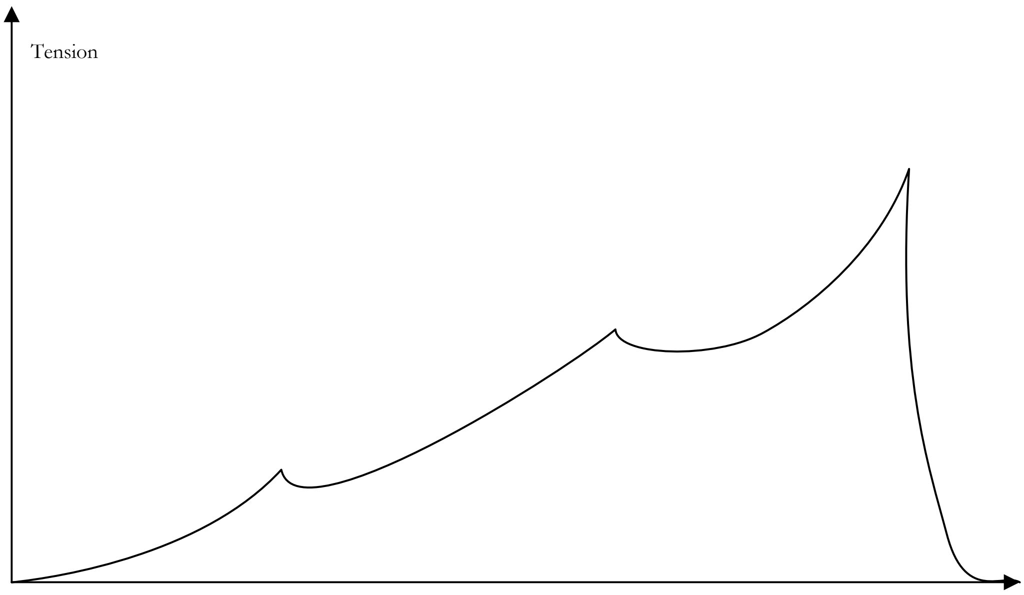

Figure 2-3: Flow of dramatic tension according to Seger (1987, p.5).

2.9.2 The Monomyth

Christopher Vogler (1998) brought to contemporary popularity what Joseph Campbell (1968) had written three decades before: A mythic structure that all great stories are supposed to be based on.

Campbell called this structure the *monomyth*[28], but it is also often referred to as the *Hero's Journey*. Its basis are three elements which he calls the nuclear unit of the monomyth: separation – initiation – return.

> "A hero ventures forth from the world of the common day into a region of supernatural wonder: fabulous forces are there encountered and a decisive victory is won: the hero comes back from this mysterious adventure with the power to bestow boons on his fellow man."
> (Campbell 1968, p.30)

[28] A term borrowed from James Joyce's *Finnegans Wake* (1939, p.581).

He described each element in more steps, resulting in a detailed monomyth which consists of 17 parts (see Figure 2-5).

Upon these ideas, Christopher Vogler built his famous book "The Writer's Journey: Mythic Structure for Writing" (1998) He divided the journey in only 12 steps, as shown in Figure 2-4.

There are also several other variations based on Campell's original monomyth, for example an eight-step-version by David Leeming (1981).

II. Departure
1. The Call to Adventure
2. Refusal of the Call
3. Supernatural Aid
4. The Crossing of the First Threshold
5. The Belly of the Whale

III. Initiation
1. The Road of Trials
2. The Meeting with the Goddess
3. Woman as the Temptress
4. Atonement with the Father
5. Apotheosis
6. The Ultimate Boon

IV. Return
1. Refusal of the Return
2. The Magic Flight
3. Rescue from Without
4. The Crossing of the Return Threshold
5. Master of the Two Worlds
6. Freedom to Live

Figure 2-5: Detailed structure of the monomyth (cf. Campbell 1968, p. ix-x)

Act I – Departure, Separation
1. Ordinary World
2. Call to Adventure
3. Refusal of the Call
4. Meeting with the Mentor
5. Crossing the First Threshhold

Act II – Descent, Initiation, Penetration
6. Tests, Allies & Enemies
7. Approach to Inmost Cave
8. The Ordeal
9. Reward (Seizing the Sword)

ACT III - Return
10. Road Back
11. Resurrection
12. Return with Elixir

Figure 2-4: Detailed structure of Vogler's Hero's Journey (cf. Vogler 1998)

2.9.3 Propp's Morphology of the Fairy Tale

In the beginning of the last century, the Russian structuralist Vladimir Propp (1968) did an extensive analysis of Russian fairy tales[29]. He came to the conclusion that all fairy tales, despite their variety in characters and actions, are based on a limited number of generic characters and their functions.

Instead of specific characters, Propp sees only seven generic characters, or spheres of action, in every Russian fairy tale: Villain, donor, helper, princess, dispatcher, hero and false hero (cf. Propp 1968, p. 79-80). These seven characters can execute 31 fundamental actions, or functions:

> "*Function is understood as an act of a character, defined from the point of view of its significance for the course of the action.*" (Propp 1968, p.21, original italics)

Not every function has to appear in each fairy tale, but the sequence of the functions is strictly uniform. (cf. Propp 1968, p.22) Propp assigned each function a symbol, so that the structure of any fairy tale can be expressed as a compact formula.

$$\gamma^1\beta^1\varphi^1A^1C\uparrow \left\{ \begin{matrix} [DE^1 \text{ neg. } F \text{ neg.}] \\ d^7E^7F^9 \end{matrix} \right\} G^4K^1\downarrow [Pr^1D^1E^1F^9 = Rs^4]^3$$

Figure 2-6: Structure of one exemplary fairy tale (Propp 1968, p.99)

This formulaic basis of Propp's morphology has made it quite popular within the field of computational story generation and interactive drama. (see for example Grasbon / Braun 2001; Paiva / Machado / Prada 2001; Peinado / Gervás 2004; Fairclough / Cunningham 2003; Faircloth 2004)

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[29] Although the title of the translation of his work contains the more general term folktale, Propp specifically focused on fairy tales. (cf. Propp 1968, p. ix)

2.9.4 Application

Whether these structures make good stories or not is under constant debate. The question in this case, however, is different: Can these structures be used to guide a user into enacting a prewritten story?

I think not. Those structures have primarily been created from an analytic point of view. While their applicability to creating stories is at least debated, it is largely unknown whether the recipients recognize – consciously or subconsciously - such structures at all. Without recognition, users won't be guided through an interactive story by such structures.

Even if we assume that users indeed recognize them, there is still the problem that the structures work on a relatively high abstraction level. None is working at a level which is detailed enough to tell / suggest to the user what to actually do next. For example, "doing something which will turn the story in a new direction" (reaching one of Syd Field's plot points) is nothing that the user can do directly. She has to think about it and decide what she can do to fulfill the structure – and this won't automatically be clear.

Generally, following such structures is a process which is much closer to authoring than to experiencing a story. It requires thinking on a kind of meta-level; thinking from a detached point of view; thinking about the story as a story and less as an experience. Even if it worked, it would probably work against the goal of immersion.

That being said, authors can still choose to follow any of these story patterns in their stories, it just won't have any effect on the linearity issues. The structures can still be used to guide the author in creating a compelling storyline. Whether or not to use such structures is merely an artistic decision, but won't help the users to find their way through the stories.

2.10 Spatial Guidance

For an interactive story which takes place in a simulated environment, the design of this environment is very important. Of course, the environment is always important[30], but in linear interactive storytelling a well designed setting is even more important. Users need to find their way intuitively. If the user gets lost, the dramatic flow is endangered; the user might become frustrated and/or deviate from the planned storyline.

There is a whole science which analyzes how human beings interact with their environment and find their ways within it – known under the evidently named term *wayfinding* (see Passini 1992; Arthur / Passini 1992; Golledge (ed.) 1999). Although this research field deals with the real world, the insights are probably also relevant for virtual worlds.

Aaron & Elaine Cohen (1979, p.189-191) list five main categories of wayfinding needs: Identification, direction, prohibition, information and status. Most of these needs can be subtly handled by careful architectural design – except the conveying of raw information.

Prohibition, the discouragement to enter certain areas, is one of the most interesting aspects for linear interactive storytelling. Unless a story is taking place in a very restricted environment (like a prison cell), the user needs to be restricted to the places relevant for the story. Blatantly blocking all "wrong" exits might be effective – and even acceptable due to common conventions in simulated worlds – but are also a possible source of frustration. Optimally, the user won't even try to take the wrong way. This should be even more effective when combined with direction techniques, which simultaneously emphasize the "right" exits.

Aaron & Elaine Cohen (1979) claim that prohibition and direction are the most effective fields for architectural wayfinding techniques. Unfortunately, they don't offer many of these techniques. Their primary suggestion is to work with lighting levels. People are drawn to brighter areas and less likely to enter areas with lower light levels. Colourful areas also arrest attention.

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[30] A point which has been especially well described by Andrew Glassner (2004, p.383-384) who suggested to treat the environment like a character.

Another suggestion is to use furniture to form clear lines of movement. (cf. Aaron / Cohen 1979, p.189-190)

Peter Zec (2002, p.82-87) notes that orientation can be guided through light, dimensions, forms, colours and materials – also without going into much detail.

Paul Arthur and Romedi Passini (1992, p.116-140) write about optimal designs for entrance areas, use of paths, strong vertical accesses, circulation systems and exits. Their descriptions are more extensive – too extensive to cite here in detail. They also note that settings do not necessarily have to be simple for people to find their way. On the contrary, over-simplistic buildings result in boredom, which is not helpful for wayfinding (cf. Arthur / Passini 1992, p.43).

Another field which investigated the effect of locations, or *atmospherics* (Kotler 1973-1974), on the behavior of human beings is marketing. Unfortunately (and understandably), most studies measure the effect of environment variables on sales figures. Sales figures are hardly relevant for linear interactive storytelling, so the bulk of these studies are irrelevant (for an extensive overview see Turley / Milliman 2000). But there are also a few studies whose results might be useful for designing locations for linear interactive storytelling.

For example, Joseph Bellizzi, Ayn Crowley and Ronald Hasty (1983) found that consumers are physically drawn towards environments in warm colors like yellow and red (although consumers found those environments generally unpleasant). Charles Areni and David Kim (1994) showed that brighter lighting results in consumers handling and examining more merchandise. Both findings are consistent with the theories from architectural wayfinding mentioned above.

A study investigating visitor behavior in zoos found that visually competing exhibit objects reduced the number of visitors actually stopping at these objects (cf. Bitgood / Patterson / Benefield 1988). If this holds true outside of zoo settings, this would support the intuitive theory that areas which are important for the story should not be next to competing visual elements. The same study also showed the strong influence of auditory cues on visitor behavior. Visitors were easily drawn towards auditory stimuli and also very easily distracted by other noises. Applied to simulated worlds, it should be possible to draw users towards desired areas by the use of sounds[31].

[31] This technique might be impaired by the limitations of current technology in creating locatable sound sources.

2.11 Lessons Learned

Linear interactive stories should optimally be based on schemas, especially scripts. Sources for established scripts are scarce; authors are largely on their own on the search for usable scripts.

Stories should encourage automatic processing modes. They can do this by creating circumstances under time-pressure in which the cost of being wrong is low and the cost of being indecisive is high. A positive mood might also be helpful. Disconfirming expectancies is detrimental to automatic processing. Priming important events beforehand could increase the probability that the schema / script is really used.

According to the theory of action identification, tasks given to the user should be defined at a higher level of abstraction if they are easy, and more in detail if they are hard. The user should also have the expectancy to succeed in the task, because then she will put more energy into it and is less likely to switch to some other task. If such expectancies are confirmed, the effect of future expectancies is even larger.

Other characters can be used to directly influence the user. Also, the design of the environment can guide the user in her spatial orientation, preventing too many linearity-threatening explorative actions.

Obviously, not every type of story is equally suited for linear interactive stories. A typical murder mystery focuses on problem solving, therefore working against automatic processing modes. Stories focusing on the inner thoughts of characters would be equally problematic. Tragic stories which end with the suicide of the protagonist would be another ill-suited genre. After all, a story will hopefully not have enough emotional power to drive a user into suicide – even virtually.

Stories should instead focus more on actions – not necessarily in the sense of action movies[32], but in the sense of doing things. Episodic stories can be especially interesting, because they are a way to couple a series of scripted events without the need to build transitions[33].

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[32] Still, action-movie-like stories do indeed possess many elements desired for linearity, like time pressure and a high cost of being indecisive.

The author can choose to follow one of the major story paradigms, but it won't have much influence on the linearity.

[33] Aristotle was not very fond of episodic stories, though: "Of all plots and actions the episodic are the worst." (Aristotle 350BC, p.6)

3 Interactive Guidance

Even the best linear story will not prevent a human user from deviating from the planned story progression sometimes. How can an interactive storytelling system react to such deviations?

In recent times there has been an increasing scientific interest in non-linear interactive storytelling systems. This chapter takes a look at those systems, which seem most promising to employ strategies which can be adapted to linear interactive storytelling.

3.1 Façade

> "Façade is an artificial intelligence-based art/research experiment in electronic narrative – an attempt to move beyond traditional branching or hyper-linked narrative to create a fully-realized, one-act interactive drama."
> (Mateas / Stern 2002)

Façade is probably the most widely known experiment in interactive non-linear dramaturgy. It was publicly released as a free download in July 2005[34].

In Façade, the player meets with a befriended married couple, Trip and Grace. Soon it becomes clear that their marriage is not working very well anymore, it has merely become a facade. Through careful discussion, the player can save the marriage, see its end or something in between.

Figure 3-1: A Screenshot of Façade

The small world of Façade, consisting of a living room and kitchen, is rendered in very simplified 3D with a comic-like look[35]. The two characters Trip and Grace also have this simplified look, with barely any detail. Their faces, on the other hand, contain everything needed to display different states of emotions. The level of mimic which can be shown in Façade is remarkable and used extensively.

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[34] http://www.interactivestory.net/ (17.4.2008)

[35] There also efforts to port Façade into an augmented reality environment (see Dow et al. 2006; 2007). However, these efforts make use of the same, unmodified story models and are therefore not treated separately here.

The most important input device for users is the keyboard. Façade tries to understand natural language which can be typed at any time in the story. Users are not required to follow a fixed syntax; the system tries to interpret colloquial language. (cf. Mateas / Stern 2004) The context provided by the story helps to cover glitches in the interpretation, just like misunderstandings happen in real world heated discussions.

The smallest story unit in Façade is called JDB – Joint Dialogue Behavior. Such a JDB contains a short exchange of dialog of the two main characters. Typically, it contains 1 to 5 lines of dialog and lasts a few seconds.

A unit on the highest level of story structure in Façade is called a *beat*[36]. It contains anything between 10 and 100 JDBs, organized about a common narrative goal. Each beat is annotated with a set of preconditions, priorities, weights and a set of story values which it intends to change. Priorities and weights can also be dynamic, meaning that they change over the course of the story. The story values include for example a value which represents the tension level in the story. It is used to organize the beats so that the complete experience has a flow similar to a classic tension curve.

This organizing of the beats is done by the beat sequencer, sometimes also called drama manager. The beat sequencer lies dormant most of the time. It only becomes active when a beat has finished and a new beat has to be selected for execution. Only one beat can be active at a time, although it can be interrupted by user interaction. The beat sequencer only chooses which beat to start next. It does not control what happens while a beat is running, nor can it stop a running beat. (cf. Mateas / Stern 2008)

The beat sequencer selects the next beat based on the following strategy (shortened[37] from Mateas / Stern 2002, p.21-22):

1. All beats with fulfilled preconditions are selected.

[36] Originally, this term was coined by Robert McKee (1999, p.37-38) for the smallest dramatic unit. However, beats in Façade are much larger structures. They are more like scenes, a term which has indeed been used by Michael Mateas and Andrew Stern in an earlier publication (Mateas / Stern 2000).

[37] Technical details, like initializations of variables have been skipped in this summary.

2. Calculate all dynamic priorities for these beats and select those which share the same and highest priority value.
3. These beats are then scored according to their effects on the desired story arc.
4. The score is multiplied by the weight of the beat.
5. Finally, one beat is randomly chosen from all selected beats. The calculated score determines the probability with which each beat is chosen. The beat with the highest score is not automatically chosen, but has the highest probability of being chosen.

The more beats the authors provide to the system, the more dynamic it can become. The sequencing of beats is responsible for what Mateas and Stern call global agency (cf. Mateas / Stern 2005b). The user influence is represented in the sequencing algorithm through the dynamic priorities and weights, which can depend on user action (topics which the user brought up, for example). User intervention can also cause a beat to fail and abort without reaching its desired effects, resulting in the selection of a new beat and therefore alteration of the overall story progression. (cf. Mateas / Stern 2002)

Each beat is structured around a set of *beat goals*, representing the course of action without user interaction. A beat typically has one transition-in goal which presents the introduction to the topic of the current beat (possibly connecting it with the previous topic), several body goals which drive the content of the beat and a transition-out goal which ends the beat, often communicating how the user has influenced the story in this beat. Additionally, a beat contains several *mix-ins*, which are beat goals that can be inserted in the goal progression in the case of user interaction. If, for example, the user is disagreeing with a character during a discussion, the current beat body goal is aborted and a reaction to the disagreement is executed instead. If the previously aborted body goal has already solved its purpose – defined by an author annotated gist point – the story continues with the next goal. If the previous one was aborted prematurely, it is resumed. For this purpose, each body goal has a reestablish JDB – a short dialog which leads back into the goal to continue. (cf. Mateas / Stern 2002; 2005; 2005b; 2008)

Another way of influencing the story is over *global mix-ins*. These are not part of beats and can be triggered at any time. They are focused around a set of topics like marriage or therapy, or around objects like a wedding photo, or as generic reactions to actions of the user like praise or flirtations. Each category of global mix-ins is divided into three tiers, so each time the user addresses such a topic, it is advanced further. When such a topic is brought up, the currently active beat is interrupted and the global mix-in executed instead. These mix-ins themselves cannot be interrupted before their gist point. They are authored to reach their goal fairly quickly, so that user interaction can only interrupt after the gist point has been passed, so that the mix-in does not have to be repeated. (cf. Mateas / Stern 2002)

3.1.1 Relevance for Linear Interactive Storytelling

Façade's non-linearity on the story-level comes from the dynamic ordering of beats. It should be possible to write a story with a fixed sequence of beats. However, Façade has no concept to guide the user towards the completion of a beat. If the user's interaction does not lead to the completion of the beat, it is simply aborted and a new one is started. In a linear story this would not be possible.

The language in which the beat-contents are written should enable the author to deal with this problem manually, but Façade does not offer any direct support for it.

Still, Façade's architecture for creating artificial characters has shown that it can indeed create believable characters. It would be interesting to use this architecture within another system which can support interactive guidance[38].

[38] The architecture already has been used in another project called In-Tale. See chapter 3.6 for details.

3.2 Moe

One of the earliest and most cited approaches to interactive drama was described by Peter Weyhrauch in his doctoral thesis *Guiding Interactive Drama* in 1997. He envisioned a drama manager, called Moe, to be part of the equally famous Oz Project (for details about the Oz Project, see Weyhrauch 1997, p.5-7; Mateas 1997).

Moe is designed not only to create a non-linear dramatic experience, but also to let it follow a long-term structure which expresses the artistic intent of its author. Weyhrauch called this the *destiny* of the user:

> "Even though the User has the freedom to choose what to do, say, and think, she must have a destiny, which is the artist's vision for a particular interactive drama. Unlike Aristotle's notion of destiny, which is a sequence of actions and events specified by the gods (or in this case the artist), my notion of destiny is abstracted from exact events. A destiny is a set of qualities that the action must have.
>
> […]
>
> [...] the purpose of all the technology implemented for this thesis is to allow the artist to specify a destiny in such a way as to let the system guide the User's experience at a later time, so that she may fulfill her destiny."
>
> (Weyhrauch 1997, p. 3, 9)

This focus on an artistic vision is what makes Weyhrauch's concept so intriguing. Moe is not built upon absolute rules or dramatic theories, it is a framework to encode such a vision or destiny and guide the user's experience towards it.

Moe is based on an idea by Joseph Bates a few years earlier. He proposed to see interactive drama as an abstract adversary search problem. This means to handle the story like a game between the director and the user. The goal of the director is to create an ideal story, judged by an evaluation function, while the user is just following his personal goals. An adversary search algorithm can then be used to find the optimal sequence of user and system actions. (cf. Bates 1992)

Peter Weyhrauch calls these actions User Moves and Moe Moves. User Moves represent key events in the interactive story which happen solely through the normal progression of the story, without system intervention. Moe Moves are the actions which the system can take to influence the development of the story. User Moves are the core of the story. The artist defines them to describe the story structure. They are represented in a partial order in a directed acyclic graph (cf. Weyhrauch 1997, p.26). This means that they have no strict complete order which would describe for every move when it has to happen, but does this for parts of the moves. For example, it does not matter if the user first discovers tracks on a crime scene or finger prints on the murder weapon, but she can only analyze the finger prints after they have been found.

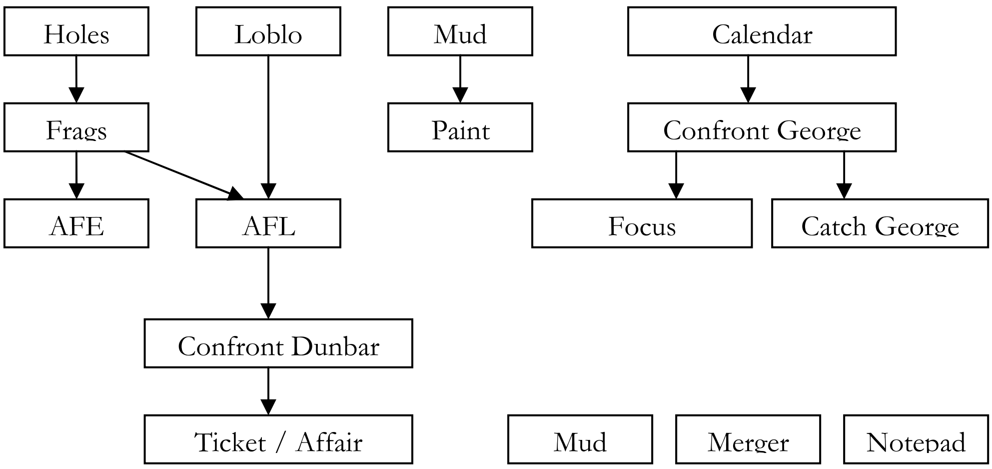

Figure 3-2: User Moves in a partial order directed acyclic graph. (cf. Weyhrauch 1997, p.30)

The evaluation function tries to evaluate how much an experience matches the desired optimal experience. It returns a numeric value which symbolizes the quality of such an experience. The system can then try to influence the experience to push it towards an ideal one. (cf. Weyhrauch 1997, p.41-74)

The search algorithm[39] is responsible for finding the sequence of moves which is rated best by the evaluation function.

3.2.1 The Evaluation Function

Although Weyhrauch discusses an exemplary evaluation function in his thesis, the content is not strictly defined (and not meant to be). Each artist has to decide what is desirable in his interactive drama. He can then encode this destiny that he wants to user to pursue in his custom evaluation function accordingly.

Weyhrauch's prototype function is divided into several sub-functions, each of which measures different features of the experience. Although the details of the implementation are not important for this thesis, I want to give a short overview of its basics, because it contains several interesting concepts which can also be applied to linear interactive storytelling.

It should be noted, though, that these features do not represent absolute truths based on scientific evidence. They are rather the expression of Weyhrauch's artistic assertions about what makes a good experience of his sample story "Tea for Three". He himself emphasizes this repeatedly and devoted a small chapter (Weyhrauch 1997, chapter 1.6.2, p.16) to explain his artistic sources.

3.2.1.1 Thought Flow

Weyhrauch argues that a good experience should not let the user's thoughts switch between topics too often:

> "I think it makes a better experience if the User rides one train of thought for a few USER MOVES in a row, instead of bouncing back and forth between topics. To me, this adds a sense of consistency and allows a sort of logic of action to build up." (Weyhrauch 1997, p.43)

A smooth flow of thoughts is probably also desirable in linear experiences, because I believe it is beneficial for schema- and script-based stories. If the thoughts keep bouncing back and

[39] The search algorithm is primarily a technical problem of efficiency, and therefore not discussed in this thesis. Please refer to the original source (Weyhrauch 1997, p.89-172) for more details.

forth, the user would have to keep switching between different schemas - and it is unclear how well this works or if this would increase the danger of loosing track.

3.2.1.2 Activity Flow

> "Activity Flow is similar to Though Flow, except that instead of measuring how the User's thoughts are bouncing around from topic to topic, it measures how the User's body is bouncing around from location to location. I think the User's experience is better when she does not run from place to place doing only one thing in each spot, only to return later to do something else. I prefer the User to do all her business in a place at one time. That way, the amount of uninteresting walking around is minimized, and the experience flows more smoothly." (Weyhrauch 1997, p.46)

I can only agree with this impression. Walking from one place to the other is a process which is often completely uninteresting. In movies, this process is simply cut out. Just imagine a movie that actually shows the protagonist driving from one end of the town to the other. Unless there is something special happening on the way, the dramatic tension would certainly break.

If an interactive story is based on a simulated world where such cuts are not possible, the process of walking around can have a similarly disastrous effect – especially when happening repeatedly.

Some adventure games implement similar "cuts" like movies do. Using a menu, the user can choose to move to a certain location and instantly arrives there. This method reduces at least the travel times. One could argue that even with this jump feature, the experience would still suffer from too many unnecessary location changes – it would appear rather cluttered.

I would also add that this has not necessarily to be tied to location changes. In scenarios which offer several possible activities in the same location, a constant switching between activities would also appear harmful to the experience.

3.2.1.3 Options

This feature relates to the perceived freedom of the user in the story. It is basically what Janet Murray refers to as *agency* (Murray 1998, p.126).

> "In Tea for Three, I don't want the User to feel as if there is only one right path at any given point. I want her to feel as if there are several significant options and that she is free to pursue any of them. *Options* is a measure of interactivity: Does the User feel as if she has real control over her actions, that there is sufficient freedom to act, and also that those choices have meaning in the experience?" (Weyhrauch 1997, p. 48)

Obviously, this is an important feature for interactive non-linear dramas. One might argue, though, that too many options might be detrimental to the experience. Having too many options at hand might lead to a more cluttered Thought Flow.

Weyhrauch favors having more choices in the beginning rather than in the end of the story. This conforms to Laurel's theory of dramatic potential ("The flying wedge", Laurel 1993, p.70).

In linear experiences, this is a two-edged sword. For true linearity, only one option can be real. The more options there are the higher is the risk of the user choosing "wrong" one. So basically more options lead to an increase in perceived freedom, but also in an increasing danger of story deviation. Authors will have to find the right balance for their stories.

3.2.1.4 Motivation

> "*Motivation* measures whether the User has motivation for performing her actions in the world. I often think of a successful experience as one in which the User has a series of goals, which she alternately acquires and satisfies. Each piece of the scenario is like a little story itself, with a beginning, where the goal is acquired; a middle, where the goal is pursued; and an end, where the goal is satisfied. However, the small story will not make sense if the goal is satisfied before the User even knows she has the goal. So, *Motivation* lets the evaluation function measure whether the goal is present when the goal-satisfying User Move takes place." (Weyhrauch 1997, p.52)

Weyhrauch differentiates this feature into two parts: Whether the user is in pursuit of the right goal when it is satisfied, and whether she is in pursuit of a goal at all. He considers it less problematic when a goal is satisfied while the user is trying to achieve something else, than when she is without a goal at all.

A clear goal is especially important for linear experiences. A user who is aimless is more likely to deviate from the story.

3.2.1.5 Momentum

The feature *Momentum* is a kind of manual influence on the overall evaluation. It is only there to allow the author to specify key points which work exceptionally well together. If such a specified moment follows its perfect predecessor, the rating gets a bonus point.

> "Because it does not consider context, *Momentum* is possibly risky for an artist. *Momentum* will score for a pair of Moves regardless of what has happened in the past. For this reason, only three pairs of USER MOVES have *Momentum* in *Tea For Three*." (Weyhrauch 1997, p.56)

3.2.1.6 Intensity

Intensity tries to model the development of dramatic tension over time. Weyhrauch created a function, based on changes in what the user knows, which would allow implementing different models of dramatic development. He first measures the excitement at each point of the story and later compares it to an ideal excitement graph, which can be freely defined.

In his example implementation, Weyhrauch based the measurement of excitement on suspected changes in the user's knowledge.

> "[...] in my model excitement comes from solving the mystery. Practically, this means gaining knowledge about the mystery. For *Tea For Three*, knowledge is measured by the nine facts. The User can either know or suspect each fact is true or false. If the User verifies that [the victim was killed by a certain drug], she should be quite excited. Naturally, verifying some facts will be more exciting than others. This shall be reflected [...] by annotating a goal with its importance." (Weyhrauch 1997, p.59)

Weyhrauch's system judges the knowledge of the users by tracking their actions. Certain knowledge is associated with key points in the story. For example, if the user discovers mud on the balcony of the crime scene, the system thinks that the user now suspects that the balcony was the way of escape for the killer. When the user finally discovers a ladder, scratched off paint on the railing and two holes in the earth below the balcony, the system thinks that the user now definitely knows that this was the way of escape.

Also, different changes in the knowledge-level are weighted according to their suspected impact. For example, going from strongly suspecting that something is true to verifying that something is true has a stronger impact than going from knowing nothing to lightly suspecting that a fact might be true. Confirming (or suspecting) that facts are false is generally considered less exciting than the according positive knowledge/suspicion.

Different key facts are weighted according to their suspected impact on the user's excitement. Knowing who the murderer is is weighted more than knowing the motive, for example.

All added up, these weighted changes in knowledge give a numeric representation of the user's excitement at each point of the story.

While this measurement might be a good orientation, I doubt that it is very precise. Often, excitement is not that strictly fixed to changes in certain knowledge. Other factors, like action and suspicions, influence it. For example, there is a scene in Tea For Three where the user catches one suspect in the process of destroying evidence. There is more excitement hidden in this scene, than just gained knowledge. There is action because the user reaches him just in time. There is fear that the suspect might already have destroyed something important. There is the general excitement that this might be the end of the story. All these factors are not represented in a purely knowledge-based calculation of excitement.

I would propose to extend this system with a way that lets the author manually "boost" the excitement-value for certain key points. That way, all these factors which cannot be determined by an algorithm could be included manually.

As already mentioned, the final excitement values are then compared to an ideal excitement graph. The more the excitement matches the ideal graph, the better. Weyhrauch considers the later parts of the graph – which represent the ending – more important than the beginning. Therefore, the matching algorithm assigns more weight to later matches. Discrepancies in the later part of the graph have more impact than those in the beginning.

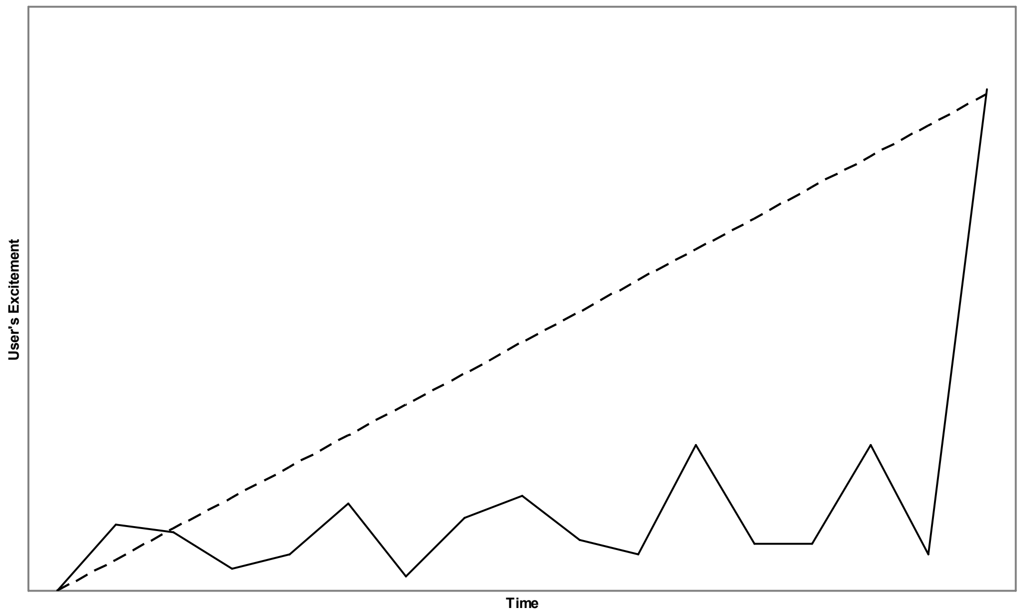

Figure 3-3: Ideal (dotted) vs. measured tension curve as measured in a "good" experience. (cf. Weyhrauch 1997, p.71)

In his example, Weyhrauch did not choose a classic dramatic arc as the preferred ideal graph, but a constant rise to a final climax (see Figure 3-3). I would prefer an excitement graph with a more exponential development – but that is more of an artistic decision. For longer stories, one could prefer a classic, three-parted dramatic arc.

3.2.1.7 Manipulation

> "[Manipulation] is a measure of how much the User perceives her experience has been pushed-around or manipulated by the system." (Weyhrauch 1997, p. 71)

This measurement is – like all features of the evaluation function – represented by a number.

Since a Moe Move is not exactly one action, but a dynamic piece of program that can have any number of effects under different conditions (see next sub chapter), detecting the impact on the perceived manipulation is difficult. This impact has to be calculated for potential moves that have not really happened, yet, so it is not possible to just keep track of the actions. The perceived manipulation may even vary for the same actual system action, because not each action is noticed by the user. For example, if the system locks every door in a room but one, the user will not feel manipulated at all if the user only tries the open door. On the other hand, if the user tries the open door last, she will feel very manipulated. The same system action can lead to different levels of felt manipulation. Peter Weyhrauch decided to simplify this problem by manually assigning a fixed manipulation value move to each Moe Move. This estimated value represents the manipulation which will most likely occur – as judged by the author. (Weyhrauch 1997, p.94-96)

In general, a measure for manipulation is a very good idea, also for linear experiences. Users should also feel as little manipulated as possible, no matter whether they are experiencing a linear or non-linear story.

3.2.2 Moe Moves – Guiding the User

The more or less subtle ways to influence the experience of the user are called Moe Moves.

The name Moe Move is a little misguiding, because each Moe Move can contain several actions which can be executed independently. These actions can modify any part of the system. They can change character behaviors, objects in the world or the way in which they are presented to the user. One could say that a Moe Move is a set of available moves to reach one desired effect. Each Moe Move and its subparts have to be programmed individually by the artist.

> "The set of Moe Moves is like a bag of tricks that Moe can use to control aspects of the User's experience. Each interactive drama will have its own set of artist created Moe Moves, crafted specifically to have certain effects in that interactive drama." (Weyhrauch 1997, p. 94)

The specific Moe Moves for Weyhrauch's Tea for Three are not important for this thesis, but I still want to mention the categories of moves which Weyhrauch created:

- *Deniers*
  Deniers are moves which prevent certain key events from happening. In Weyhrauch's non-linear model these are useful for changing the order of important story events. (cf. Weyhrauch 1997, p. 97)

- *Delayers*

  Delayers are similar to deniers, but they only postpone key events instead of denying them completely. (cf. Weyhrauch 1997, p. 99)

- *Causers*

  Being the counterparts to deniers, causers make specific key events happen immediately. (cf. Weyhrauch 1997, p.97)

- *Hints*

  Hints are a less invasive version of causers. They do not necessarily enforce an event, but only encourage it by dropping a hint. The user might follow this hint, or maybe not. (cf. Weyhrauch 1997, p.101)

- *Move substitution*

  Move substitutions replace one user move by more user moves. This is possible when the key event of a user move is under control of the system. In Peter Weyhrauch's example, a police lab can inform the user about two analysis results instead of only the one requested. (cf. Weyhrauch 1997, p.100)

3.2.3 Related Projects

Nelson et al (2006) created a text-based system which employs a lot of Peter Weyhrauch's ideas. They mainly focused on investigating possible search algorithms. They also introduced new features for the evaluation function which help evaluating stories with multiple endings.

Sharma et al. (2007) added a player modeling module which keeps track of previous user experiences. Users are asked to evaluate the story at the end of the experience. Upon a new experience, the systems tries to find previous experiences with a similar sequence of events and system interventions which lead to a good rating and tries to reproduce it. This way, it can adapt to different preferences of different players.

In an evaluation study with 22 test users, Sharma et al. (2007b) monitored that the drama manager could indeed improve the user experience.

3.2.4 Relevance for Linear Interactive Storytelling

On the first glance, it would be tempting to use Moe's architecture and just supply it with a totally ordered story, instead of a partially ordered one. However, this would cripple the guidance system since it has no means to guide the user between user modes. Moe's decision to add a Moe Move or not solely depends on the sequence of User and Moe Moves that have happened. With linearized user moves, the sequence of user moves is always the same and Moe has no basis to judge whether or not to execute a moe move.

So basically, Moe does not work with linear stories.

Still, the principles of the evaluation function could be useful in other frameworks. For example, a system could use it to evaluate which system intervention to execute once it has determined some other way that intervention is necessary in the first place. The categories of Moe Moves can be a useful inspiration for creating such system interventions in other frameworks.

3.3 Interactive Drama Architecture (IDA)

The Interactive Drama Architecture (IDA) is a framework which uses an "omniscient director agent" to guide a story which has been pre-written by an author. For presentation, IDA uses the commercial game engine Unreal Tournament[40]. (cf. Magerko / Laird 2004)

Similar to the approach of Bruce Blumberg and Tinsley Galyean (1995), IDA uses semi-autonomous characters. These characters are capable of autonomous behavior, but can also be directed on several levels by the director agent. They are written in Soar, a programming architecture for artificial intelligence.[41] Left alone, the characters follow their own goals and needs. For example, they go to a warmer area if they freeze, or light a fire. The director agent can influence the characters on a high level, by giving them new goals (like "explore") which they in turn pursue autonomously. Alternatively the director can give the synthetic characters very specific instructions (like "move to that specific point" or "perform dialog line X"). (cf. Magerko 2006, p.43-48; Magerko et al. 2004)

The story is described by a collection of key points, called plot points. These plot points are organized in a partially ordered graph (see Figure 3-4). That means it is defined which plot points follow one another, although not every plot point is required to have a predecessor or successor.

[40] For more details about the technological foundations of IDA, see Laird et al. 2002.

[41] http://sitemaker.umich.edu/soar (28.4.2008) For more details about Soar, see Lehman / Laird / Rosenbloom 2006; Newell 1990.

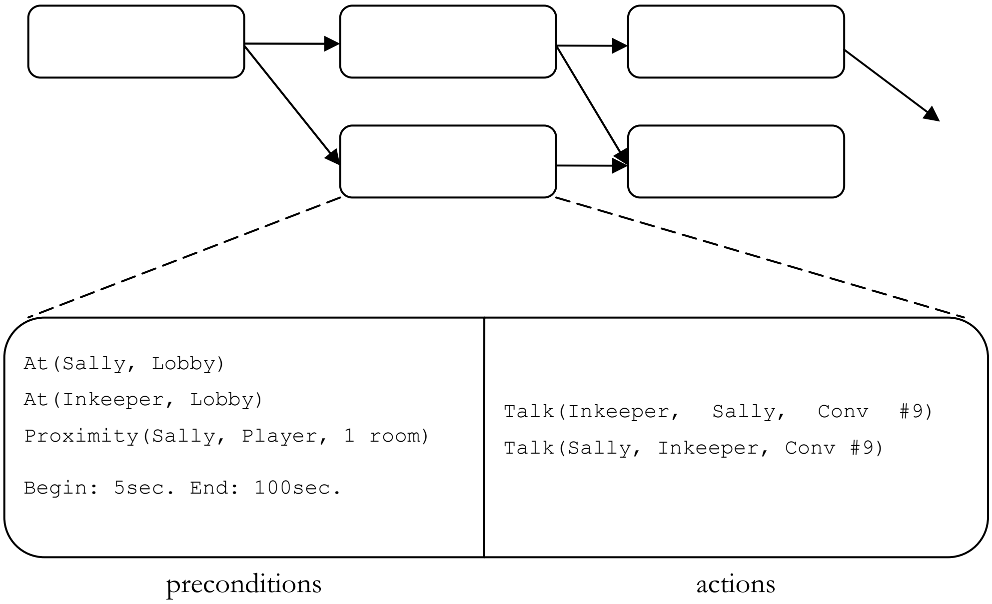

Figure 3-4: Story representation in IDA (cf. Magerko 2006, p.52)

Each plot point has a set of actions which are executed by the characters once the plot point becomes active. A set of preconditions defines when it becomes active, preconditions being anything from the location of the user to mental states of characters. A special precondition is the timing constraint which defines when a plot point should be reached. This gives the author a way to control the pacing of the story.

Beginning with the topmost plot points, the story is traversed along the hierarchy. At the beginning of the experience, every plot point that does not have a predecessor (no parent) becomes active. This also means that more than one plot point can be active at once – if the author of the story structure decided to construct it that way. Still, only one plot point is really executed at a time[42]. Once an active plot point is completed, any plot points that have not yet been performed and that do not have any parents that have not yet been performed are activated. (cf. Magerko 2005, p.4/6; Magerko 2006, p.51-54)

[42] See Magerko 2006, p.67-68 for details on the selection in case of multiple active plot points.

An interesting option for authors is the use of variables in describing the story actions and constraints. Instead of defining that, for a plot point to happen, the user must be near to the barkeeper, the author could also define that the user must be near to any character, no matter which one exactly. In other plot points, the author can then refer to this same character, whoever it might have actually been. Brian Magerko calls this feature *least-commitment authorship*. The advancement of this technique is that the author has to be only as specific as necessary. This adds some additional variability in the story – although primarily in less important parts, because most authors will want to describe the important parts in specific details. (cf. Magerko 2006, p.58)

The part of IDA, which is responsible for keeping the progression going, is called the director. It can manipulate characters and objects in the world to influence the story. If a plot point is due for execution (as defined by the timing constraint), but is still awaiting preconditions to be met, the director will intervene to fulfill these conditions. An easy example would be the condition of a character being in a certain location. If the character is still somewhere else and the timing constraint marking the beginning is already met, the director will instruct the character to move to the desired location. If the violated precondition involves the user herself, the director waits until a second timing threshold is reached and then takes action to guide the user to fulfill the precondition. (cf. Magerko 2006, p.52-54)

The actions that the director can take come from a library of directions. These directions can influence about everything except the user character. For instance, the director can give synthetic characters new goals (i.e. "go in the library"), new information (i.e. "the player is now in the lobby") or specific instructions (i.e. "go one step forward"). Directorial interventions also include the removal or addition of objects from the world, or change of their physical parameters (i.e. locked/unlocked). The environment can also be influenced, for example by changing the lighting, temperature or triggering sounds. (cf. Magerko 2006, p.69-70)

Each intervention is annotated by the author with additional information which helps the director to choose which one to execute. For one, each intervention is assigned to a category of interventions. Each precondition that might need directorial support is annotated with an according category. The director then chooses an applicable intervention from this category. (cf. Magerko / Laird 2004, p.111; Magerko 2006, p.70-71) Directions are also annotated by the author with several "dimensions". These are simple decimal values from 0 to 1 which are used to generate a rating that the director can use to judge which one is best suited for a specific case. It is up to the author which dimensions to implement. The author can also choose how much weight each dimension will have in the final rating. These weights can be adjusted during the story, so that different situations can use differently weighted dimensions. Brian Magerko uses *subtlety* and *effectiveness* in his implementation, so the director could choose less subtle but effective interventions in time-critical directions and more subtle interventions in less critical situations. (cf. Magerko 2006, p.83-85)

If intervention fails, the director will not attempt a new intervention. Story progression then solely lies in the hands of the user. (Magerko 2006, p.64/77)

One strength of IDA is the director's capability to predict the future behavior of the user. This feature, called *player modeling*[43], enables the director to predict when a user might probably act in a way which is harmful to the story. The advantage of this prediction is that the director can intervene at an earlier point, when the story is not yet actually out of its planned progression ("preemptive intervention"). At such an early point, the director can use fairly subtle interventions which might not be as effective (like letting a character cough at a location where the user should move to). Without the prediction, the intervention can only happen at the last moment ("reactive intervention") which requires more effective interventions which are usually less subtle (like letting a character ask the user to come to the desired location). (cf. Magerko 2006, p.78-83)

As Justin Harris (2008, p.13-14) points out[44], another drawback of intervention at the last moment is that the user might have already put a significant effort in a plan, the fulfillment of which the system will ultimately deny. If the user is going to do something which interrupts the story progression, it is better to stop her early before she has put too much effort in her doomed strategy.

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[43] The player model needs to be created by the author. How exactly the model is created is outside the scope of this work, though. It builds upon research on predicting adversaries in computer games and military simulations (see Laird 2001; Wray et al. 2002). For a more complete description see Magerko 2006, p. 78-83)

[44] He refers to another system, but the argument is universal.

3.3.1 Relevance for Linear Interactive Storytelling

IDA could be called a hybrid between linear and non-linear storytelling. The architecture differentiates between "temporal variability" and "content variability". Temporal variability is the variability when scenes occur in the story. Content variability means variability in what happens inside these scenes (Magerko 2002, p.78). This distinction is similar to global and local agency as described by Michael Mateas and Andrew Stern (2002, p.19). An author might choose to integrate no temporal variability at all and therefore create a semi-linear storyline.

A question is, though, why the director is limited to one intervention per plot point. If the user gets stuck and the first intervention fails, the story flow will be disrupted. It seems useful to enhance the system so that a sequence of interventions can be executed. Each intervention could be annotated with another timing constraint which defines when it should lead to a success. If this deadline is met, the next intervention is executed. With each step, the director could choose a less subtle and more effective intervention.

The concept of a user model is promising. The advantages of predicting the user's behavior also apply to linear stories. The earlier a deviation from the plot is noticed, the more subtle can be intervened.

3.4 Role Playing Games (RPG)

The role of the game master in role playing games bears a striking resemblance to the role of the drama manager in interactive drama. Both are responsible for keeping the story progressing in a way that is satisfying for the players/users. The techniques that game masters employ to influence the story can therefore be quite inspiring for guiding interactive drama.

Amanda Flowers, Brian Magerko and Punya Mishra (2006) developed a categorization of such techniques. They differentiate between *in-game* and *metagame* strategies.

> "Metagame means, literally, the game above the game. Something which happens metagame in the context of a roleplaying game is that which happens above the world of the game, and within the game system instead[…]. For example, a decision made for a player's character using knowledge that the player has, rather than knowledge the character would have, would be considered a metagame decision." (Flowers / Magerko / Mishra 2006, p.3)

Each category is subdivided into *attractors*, *detractors* and *other*. Attractor strategies try to provoke a desired behavior of the player, while detractor strategies try to prevent certain behaviors.

All metagame attractors and detractors require the player to be aware of herself playing a game. This works directly against the goal of immersion in interactive drama. Only some techniques categorized as "other" are relevant to interactive drama.

"Knowing the Players" is the technique which bases on the gamemasters' knowledge of the players. This knowledge enables the gamemaster to predict the players' behavior and generally adjust the experience to their needs. In interactive drama, this technique is generally called "player modeling".

By "Making Meta Comparisons", an association with a familiar setting is caused. The goal is to let the players approach a scene with a special mindset related to the source which manipulates their behavior.

With the “Rebalancing Challenge” technique, game masters try to keep challenges on a level which create an optimal experience. Too difficult challenges usually lead to frustration, while unchallenging games are not exciting. In a way, the whole drama management approach of interactive drama could be viewed as a way to rebalance challenge. Only that the challenge is not a competitive one, but the challenge to proceed in the story at an adequate pace.

The “Phrasing” technique utilizes subtle hints in the way that the game is lead and described by the gamemaster. Smart formulations of instructions can lead the player to a desired behavior. In interactive drama, a similar effect could be achieved through smart presentation of the world through the interface. Weyhrauch’s Moe Moves, for example, can change the presentation of the story world to influence the experience (cf. Weyhrauch 1997, p.12).

Unlike metagame detractors and attractors, in-game techniques do not work against immersion. The following list contains a very short summary of all such techniques. For a more detailed description, see the original paper by Flowers / Magerko / Mishra (2006).

- In-Game Attractors
    - *Instruction*
      A character controlled by the gamemaster simply asks the players to do something[45].
    - *Inverse Instruction*
      An adversary character tries to stop the player from doing something which motivates the player to do it even more.
    - *Focus*
      Describe something in particular detail to direct the attention of the players to it.[46]

[45] See also chapter 2.7 on strategies for influencing the user through other characters.

[46] See also chapter 2.10 for references about how to design locations to guide the user’s attention.

- *Character Hooks*
  Use character motivations like threatening a relative of the player character, to provoke the desired behavior.
- *Spontaneous Conflict*
  The gamemaster involves players in a sudden conflict, most often in the form of a physical attack. This can be as simple as letting a monster appear in front of the players.
- *In-Game Rewards*
  These rewards are not targeted towards one specific character, but are rather general attractors like treasures and money.

• In-Game Detractors

- *Presence of Authority*
  A character which is respected by the players instructs them not to do something. Even the pure presence of such a character can influence player behavior.[47]
- *Suspiciousness*
  Presenting an object in a suspicious way – e.g. letting it appear dangerous – can cause players to avoid it.
- *Lack of Reward*
  If there is nothing to gain from an action, players will less likely follow this path.
- *Damage*
  Inflicting harm on a character will discourage the action which caused the harm.
- *Death*
  Killing the player character will irrevocably detract him from doing anything.

[47] Again, see chapter 2.7 for psychological references to authority.

- Other In-Game Techniques
    - *Fate*
      "[…] no matter which choice the players make in a branched situation, the results are similar to what the gamemaster was already planning to have happen […]." (Flowers / Magerko / Mishra 2006, p.5)
    - *NPC Action*
      "Action from an NPC does not always provide immediate conflict, but may provide attraction or detraction just by giving the players a small indication what is best to do next." (Flowers / Magerko / Mishra 2006, p.5)

Overall, these categories of gamemaster intervention are a very interesting source of inspiration. One could use them to create different sets of possible interventions by a drama manager in a computer-based interactive storytelling system.

3.5 MIMESIS

MIMESIS (cf. Riedl / Young 2006; Young 2001) is a system devised by the Liquid Narrative Group at the North Carolina State University.

It is a modular system that uses the commercial game engine Unreal Tournament for presentation while generating and controlling the story from a separate system. Though this modular design is quite interesting from a technical point of view, it is not relevant to the topic of this thesis and therefore won't be discussed here. Please refer to the more technical publications (e.g. Young 2001) instead.

The basic concept behind MIMESIS' story engine is that it can automatically generate coherent storylines, given only the current state of a story world (which rooms exists, which characters exists, where they are, etc), a set of possible actions (moving to another room, opening a door, shooting someone) and a goal state (for example character1 is in the kitchen and character 2 is dead). Actions of the user are included in the resulting story plan. Should the user not act according to the plan, either a new plan is generated from that point on incorporating the new user behavior, or the action of the user is intervened (for example by jamming her gun). (cf. Riedl/Young 2006)

To generate these storylines, MIMESIS resorts to an established AI research field, *planning*[48]. Planning algorithms typically take three inputs: The current state of the world, a set of possible actions in this world and the desired goal. The result is a sequence of actions which lead to the goal. MIMESIS uses the DPOCL algorithm (cf. Young / Pollack / Moore 1994) as planner. The current state of the world, which is used as input, includes characters, objects and locations. The possible actions are called *steps* and represent what actions characters (including the user) can carry out in the story. Each step has a set of preconditions – conditions which must be true before the step can be executed – and a set of effects – conditions in the world that will be changed by the step if executed. (cf. Young 2001; Riedl / Saretto / Young 2003; Riedl / Young 2006)

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[48] For an introduction to planning in computer science, see Russell/Norvig (2003) p.375--461

The planning algorithm then creates a plan which describes the whole story. This story plan also includes what the user is planned to do. Similarly to Peter Weyhrauch's User Moves, MIMESIS monitors the concrete actions of the user (like stepping forward; turning left; stepping forward) and maps them onto abstract actions (like move to next room). For each of these abstract actions, the author can define *failure modes* which can take the place of the action but has different effects. For example, if the system detects that the user is executing the abstract action "shoot important character", it can replace it with the failure mode "gun jams", preventing the central character from being shot and therefore saving the story progression. (cf. Riedl / Saretto / Young 2003; Young 2001; Riedl / Young 2006)

Note that the MIMESIS planning engine does not have a built-in representation for character consistency. Each character can potentially do anything, which could lead to very odd stories. Imagine, for example, a story which has a hero, a villain and the villain's loyal butler. The goal is for the hero to defeat the villain. So the planner finds the most-effective plan by letting the villain's butler kill the villain in the first step. That would be a very unmotivated move of the butler, leading to a not very enjoyable story. It is the author's responsibility to somehow encode character consistency into the steps of the plan – for example by adding a constraint to the killing step which restricts the butler from killing the villain. Other, non-interactive, systems have incorporated character personality models into planning structures (cf. Riedl 2004; Riedl / Young 2004).

3.5.1 User Prediction

MIMESIS itself does not have a feature that is similar to IDA's player modeling. There exists a module for the Zocalo system[49], though, which is quite similar to Mimesis and based on the same principles. This module, Kyudo, uses a plan-recognition algorithm to infer plans that the user might pursue and detect possible plan violations early before they actually occur. (cf. Harris 2008)

The advantages are the same as with IDA's user modeling approach: When the system can act earlier, it has more options how to react, can react in more subtle ways and prevents the user

[49] http://zocalo.csc.ncsu.edu/ (2.5.2008)

from getting frustrated by pursuing a plan which only fails at the last moment when a lot of energy has been put into it. (cf. Harris 2008, p.3,13-14; Magerko 2006, p.78-83)

Kyudo follows three basic strategies when trying to prevent a possible detrimental user action: Proactive intervention, proactive accommodation and proactive reordering.

Proactive intervention works similarly to intervention described above: The user action that is predicted to interfere with the plan is replaced by a failure mode. The difference is that alternatively any preceding step in the plan, which leads to the conflicting action, can be replaced with a failure mode (e.g. when the user tries to buy a gun which she might later use to shoot a central character, it is sold out). It can also insert a new action in the plan which breaks the chain of events leading to the conflicting action (e.g. a thief sneaks into the room and steals the gun). A third possible intervention is to completely remove the conflicting action from the plan. Since all actions are in the plan for a reason, the plan then has to be changed to make up for the removed action. (cf. Harris 2008, p.21-24)

Proactive accommodation changes the plan so that the user can execute the conflicting action, but the story goal is still fulfilled. Again, the difference to the re-planning without user prediction is that the plan can also be changed in steps that happen before the actual conflicting action. This gives the algorithm more space to plan and therefore can lead to better plans. (cf. Harris 2008, p.24-25)

Proactive reordering does not change, remove or add any steps in the plan. Instead, it changes the ordering of steps to influence when the conflicting action will happen. (cf. Harris 2008, p.25-26)

3.5.2 Relevance for Linear Interactive Storytelling

The basis of Mimesis is the generation of stories. This directly contradicts the goal of this thesis, which is based on an authored linear story which should not be changed. So Mimesis as a whole is not suitable for linear interactive storytelling.

However, IN-TALE (described in chapter 3.3) shows that planning techniques can also be applied to authored storylines.

Again, the user prediction is an interesting feature which can be useful for linear interactive storytelling. User prediction in Mimesis is based on plan recognition, though, so it would only be applicable if the system has a plan-based storyline (or if the story is provided for the prediction module in a planning formalism).

3.6 IN-TALE

Combining strategies from Façade and Mimesis, Mark Riedl and Andrew Stern (2006) created IN-TALE. It represents the story as a partially-ordered plan. Unlike Mimesis, the plan is not completely generated autonomously by a planning algorithm. The author provides an exemplar plan which represents the ideal progression of the story. Additionally, the author can define steps which must appear in the story, called *islands*. When the plan needs to be altered due to user interaction, the planner tries to keep make sure that these islands stay in the plan. (Riedl et al. 2008)

If the user creates a situation in which the plan cannot proceed, for example because a necessary precondition of a step is no longer fulfilled, it first tries to re-establish these preconditions by inserting new plan steps from a library of such steps. If this attempt fails, it removes events which were dependent on the now invalidated event and then inserts new events to restore the causal connections. If this is also not possible, it selects new goals and situations to rebuild the scenario plan. The basic strategy is to first try to stick to the intended story progression and then gradually introduce more fundamental changes as necessary. If everything fails, the experience becomes a non-managed virtual world which relies solely on the autonomy of the artificial characters to create an emergent narrative experience. (Riedl / Stern 2006, p.7-9, Riedl et al. 2008)

The artificial characters in IN-TALE are authored using the ABL language which was originally developed for Façade (see chapter 3.1). There are two broad categories of character behavior: Local autonomous behaviors and narrative directive behaviors. Local autonomous behaviors are rather generic activities which the character engages itself with while there are no story-specific activities to pursue. Narrative directive behaviors are triggered by the story director. They are more tightly structured and intended to perform more important and sophisticated parts of the story. Narrative directive behaviors are organized around beats, the basic plot units used in Façade. (Riedl /Stern 2006, p.5-6)

3.6.1 Relevance for Linear Interactive Storytelling

In-Tale is one of the systems which come closest to linear interactive storytelling. It is specifically designed to try to keep relevant key events in the story even with user interaction. It should be possible to implement a very linear storyline using enough island events in the original story plan.

However, the system is also designed to deviate from the planned story if the conflicting user action cannot be incorporated otherwise. As the authors themselves note, the current state of the art in narrative generation is not yet sufficient:

> "In particular, general problem solvers such as planners tend to search for efficient solutions to a problem. However, it is often the case that the most efficient solution to a problem is not the best story." (Riedl et al. 2008)

In the case of a conflicting user action which forces the system either to deny the user the action – thereby reducing agency – or computationally adapting the story, In-Tale opts for the story adaptation. Since these adaptations can (and probably will) result in stories which cannot compete with humanly authored plots, the temporary denial of agency appears to be the better alternative for linear interactive storytelling.

Besides this fundamental problem, In-Tale demonstrates that the architecture for artificial characters, which has proven to be very effective and believable in Façade, can also be used in other environments. It should therefore be possible to incorporate this technology in an environment designed for linear plots.

3.7 ALTSIM

Andrew Gordon and Nicholas Iuppa (2003) created an interactive storytelling system, ALTSIM, which is specifically designed to maintain a linear[50] (or moderately branching) story. The author creates an expected storyline[51], and the system tries to automatically adapt the story if the user actions deviate from the expected story.

ALTISM also contains a user model, but in contrast to other systems not as a separate module. The user model is instead included in the story representation. The story does not only contain events or actions, but also tries to model the mental experience of the user. This experience is described in a commonsense psychology formalism. This encoded mental experience looks about like this (the right-hand text in gray are explanatory comments and not part of the encoded experience):

(agent player)	the player is an agent
(region reg1)	there is a park
(event event1)	there is an event
(recognize-location event1 reg1 player)	the player thinks they are in the park
(activity act1 *walking)	there is an activity of going for a walk
(event event2)	there is another event
(continue-activity-execution event2 act1 player)	the player is going for a walk
(agent person1)	there is a person
(collaborative-relationship player person1)	the person is the player's friend
(event event3)	there is another event
(perceive-agent event3 person1 player)	the player sees their friend

Figure 3-5: Representation of the mental experience of the user in ALTSIM (shorted and adopted from Gordon / Iuppa 2003)

[50] The authors claim that their system can also be used to create moderately branching storylines. Due to the missing relevance for linear interactive storytelling, this aspect will not be discussed here.

[51] The paper does not include guidelines how to create a story especially suited for a linear approach.

This model is then used to create story adaptations which can be reused for different deviations. The system maintains three lists to represent the current story state: A list of previously executed story moments, a list of the expected future events (the authored story) and what the player is doing at the moment. Any possible adaptation is annotated with "trigger conditions" which consists of three equally structured lists. These conditions describe what must have happened recently in the story, what is expected to happen next and what is happening now. If all conditions match the current story state, the story adaptation is executed.

Previous Storyline:	
(continue-plan-execution ?e1 ?p1 ?a)	Someone is executing a plan
(knowledge-goal ?g ?p1)	There is a goal to know the plan
(add-goal ?e3 ?g player)	It is the player's goal
(execute-plan ?e4 ?p2 player)	The player does something at a time
Future Storyline:	
(achieve-goal ?e5 ?g ?p2 player)	What the player did achieved the goal
Player Evidence:	
(execute-plan ?e4 ?p3 player)	The player does something else at the time

Figure 3-6: Trigger conditions of a story adaptation strategy (adapted from Gordon / Iuppa 2003)

Upon execution, associated media effects (videos, texts, animations – depending on the actual environment) are added to the story. The present and previous storyline representations can be modified to reflect changes introduced by the adaptation.

Through this very abstract representation of trigger conditions, storyline adaptations are supposed to be reusable and automatically applicable to different contexts.

3.7.1 Relevance for Linear Interactive Storytelling

Being a system designed to manage linear storylines, ALTSIM's relevance for linear interactive storytelling is obviously high. Unlike In-Tale it also does not resort to computationally generation of new story fragments if deviations cannot be dealt with[52].

However, it seems doubtful whether the adaptation strategies can really be reused so easily. It seems plausible that trigger conditions can match different situations and even different stories. There probably exists a variety of deviations that happen over and over again, like when the user walks into the wrong direction, cares about the wrong evidence or talks to the wrong character. However, the actual adaptation is difficult to keep general. The reaction of the system cannot be in abstract terms; it has to react with concrete actions or changes in the environment. If the user is walking in the wrong direction, the adaptation cannot be "a friend asks you to take the right way", but "James asks you to go left". One could implement a system that tries to map such abstract descriptions back into concrete actions, but such a strategy would have limits. For example, the current state of the art in language and speech generation is not good enough to let artificial characters actually talk unless the text has been recorded / written by a human being – which would again limit the reusability because James cannot sound like George. One can imagine simpler cases which are better reusable, though. Andrew Gordon and Nicholas Iuppa mention the example of using fog to prevent the user from asking for air support. Such environmental effects can be more easily applied to diverse situations. The question remains, though, how many possible deviations can be intercepted by such generic effects.

Another critical point is the encoding of the mental experience into the story representation. Using the proposed formalism is a very demanding task, which most story authors are unlikely to have the necessary skills for. The authoring process therefore needs an additional production stage where knowledge engineers implement the previously authored story. Since the

[52] The paper generally does not explain what happens in this case. I speculate that deviations which interfere with the story and are not intercepted by a story adaptation strategy cannot be executed by the user in the first place.

story adaptation system is based on the same formalism, it will also be difficult for authors to create adaptation strategies.

Andrew Gordon and Nicholas Iuppa themselves note that interactive stories using their system are not necessarily less effortful:

> "Experience Management does not reduce the amount of effort required to constructing engaging interactive drama, but merely shifts the type of labor that is required" (Gordon / Iuppa 2003)

Also, it should be noted that a patent is pending for the technology behind ALTSIM (United States Patent 7155158), which might severely limit the reusability of the concept in the future.

The information currently available about ALTSIM (one paper and no available prototype) is generally too scarce for a final evaluation. It remains to be seen whether the advantages really justify the very complex story representation.

3.8 More

In 1995, Tinsley Galyean created the interactive story Dogmatic as part of his PhD thesis. In his model, the author creates a pool of possible events. The events are hierarchically organized. The events contain several sets of conditions which are later, when the story is being executed, used to decide which event – if any - to execute next. Basically, Galyean's system is a framework to structure the programming of such a story. It is a very abstract way of authoring which will probably not come easy to most authors who are not programmers.

Jeff Rawlings and Joe Andrieu (2003) devised a system which creates agency through multiple storylines with smooth transitions. The system does not try to resolve all possible actions within a story or guide the user to any specific dramatic destiny. Instead, deviating user behavior is rated as disinterest in the current story arc and transitions to other topics are offered.

Marc Cavazza, Fred Charles, and Steven J. Mead (2002a; 2002b) created a system in which the user takes the role of a spectator. The system is based on the interaction of artificial characters. The story emerges through the conflicting goals of single characters which have been authored at design-time. The user can intervene either by manipulating objects in the virtual world, or by feeding information (via speech recognition) to the characters. There is no narrative framework or director agent which would control the emerging story to match any dramatic guidelines.

The Defacto system (Sgouros 1999) uses a rule-based approach to generate stories in which the user is the protagonist. It first generates a set of possible actions by the artificial characters. Then it evaluates which actions result in the dramatically most interesting story.

Similarly, IDtension (Szilas 2003; Szilas / Rety 2004) generates a set of all possible actions using narrative rules and then evaluates them using a user model.

Logtell (Ciarlini et al. 2005; Karlsson et al. 2006) is a story generation which includes the user in the generation process. Instead of letting the user act in the story world, the user is asked if she wants to accept the suggested chain of events. Alternatively the user can insert new events (which again can be rejected by the generation system).

The Storytron[53] system evolves around a simplified language called Deikti with which users can communicate with the storyworld. It focuses on characters which are not scripted but instead employ abstract personality models. It is also based on turns instead of a continuous flow of time. In its current stage, the system is highly abstract for both users and authors. Storytron does not contain mechanisms to form the developing story towards any dramatic model. It declared goal is to provide the user with maximum freedom so it also contains no mechanisms to guide users towards any specific plots. Only storyworlds, models of a world and its characters, are created by authors. Authors cannot specify any specific stories. (cf. Crawford 2005)

As already mentioned in chapter 2.9.3, there are several interactive storytelling systems based on Vladimir Propp's (1968) morphology of Russian fairy tales (Grasbon / Braun 2001; Paiva / Machado / Prada 2001; Peinado / Gervás 2004; Fairclough / Cunningham 2003; Faircloth 2004). Basing stories on Propp's theory limits these stories to the structure of Russian fairy tales, which are quite restricting. Zach Tomaszewski & Kim Binsted (2007) came to the conclusion that a Propp-based approach to interactive storytelling has too many limitations (scaling problems, for example) to be successful on a more general scale.

There are even more systems and models are presented at numerous occasions (for example Spierling et al. 2002; Aylett et al. 2005; Arinbjarnar 2008, Riedl / León 2008), but since their relevance to linear interactive storytelling is neglectable, they will not be further discussed at this point. For interested readers, I recommend following the proceedings of conferences like the International Conference on Interactive Storytelling (ICIDS)[54].

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[53] Storytron was formerly known as Erasmatron. (cf. Crawford 2005) The current incarnation is aimed at commercial audiences and has its own website: http://www.storytron.com (19.6.2008)

[54] http://www.ai.fh-erfurt.de/ICIDS08/ (26.5.2008)

3.9 Lessons Learned

As a whole, almost no system discussed in this chapter could be used to create a linear interactive story. Still, several interesting features could be of use for a still-to-be-created linear interactive storytelling system.

Façade has demonstrated the power of its system for artificial characters. Characters are universally important, also in linear stories. Additionally, Façade's character technology has already been implemented in another framework, proving that it can be used without the Façade drama management approach.

Peter Weyhrauch's extensive description of an evaluation function can be of use in other frameworks where the necessity to judge a possible sequence of events might arise (probably during the decision which system intervention to apply).

The categories of Moe Moves as well as the categorization of techniques used by tabletop roleplaying gamemasters are a valuable inspiration for creating system interventions in any possible framework.

User modeling, as described with two different technologies in IDA and MIMESIS can be useful as well. It helps to predict when plot deviations might occur, so that the system can counteract earlier and more subtle.

In-Tale shows a promising plot-representation focused towards keeping the plot progression within authored boundaries. This representation would be an interesting starting point for future project which focus on stricter linearity (instead of falling back to story generation as a last resort like In-Tale currently does).

The mental experience formalism of ALTSIM is an interesting and unusual approach, but it is at this point unclear whether the advantages really justify the very complex story representation.

From all systems reviewed here, IDA is the most promising one for the realization of linear interactive storytelling – with ALTSIM being a close candidate once more information becomes available. Besides ALTSIM, IDA is the only system which allows implementing a fully linear story and tries to guide the user towards this story. The combination of IDA's drama management and Façade's architecture for artificial characters might be even more promising, although this would be a future research topic.

Finally, it should also be noted, that it is not strictly necessary to have a specialized framework to tell a linear story. A linear story without – or with simple – guidance mechanisms can be implemented in many frameworks. Adventure games, for example, are already using many story-elements. Development frameworks[55] for such games can be used to implement a linear interactive story without many modifications although typically in the 3rd person perspective. They also provide no models for guiding the story towards the desired plotline. A detailed review of these systems would be outside the scope of this work, though.

[55] For example Visionaire (http://www.visionaire2d.net, 19.6.2008) or Adventure Game Studio (http://www.adventuregamestudio.co.uk/, 19.6.2008). For text-based stories or prototypes, Inform 7 (http://www.inform-fiction.org, 14.5.2008) is a very effective development environment.

4 Application

The previous two chapters have been fairly theoretic. For illustration, this chapter will show how the theoretic findings can be applied to create a linear interactive story.

Remember, creating a linear interactive story consists of two parts: Writing the story itself, and finding ways to deal with unexpected user behavior. Chapter 2 described various techniques which will now be used to write a story which the user will most likely follow as planned. As seen in chapter 3, there is not yet a perfect system which can be used to guide the interactivity in such a story. In this example, I will therefore use a very simple strategy that I call the exception strategy.

Figure 4-1: A simple exception strategy.

The first step, creating a linear story is the most difficult and most important step. A well written story should guide most users to the desired results without the need for much intervention. A poorly written story will lead to user frustration and / or requires more work in the following steps.

Next, the author has to identify points in the story, in which the user might deviate from the intended course of the story. This process can roughly be divided into two parts: Freeform exceptions and timing exceptions.

Timing exceptions, similar to timing constraints in IDA (see chapter 3.3), occur when the user simply takes too much time to finish a part of the story. The author should define a sequence of key points and a time difference between each sequential two points. This defines the optimal timing of the sequences. There is no strict rule how detailed this sequencing should be done. The more such points are defined, the more detailed the flow of the story can be controlled, but the more work is required. A sequencing which roughly equals the scenes of the story should be a good orientation.

Freeform exceptions are used for all the things that can go wrong in between. For example, if the user tries to attack a robber instead of complying with his request. Or – simpler – if the user walks in a direction which definitely will be of no use to further the story progression. Such exceptions can be more or less critical. Some exceptions will destroy the story if not properly intercepted; others will merely delay it or produce feedback which displays the linearity of the story ("You can't do that.").

Finally, the author needs to define how the system should react on such exceptions. Chapter 3.4 showed several generic techniques used by role playing game masters, most of which are also applicable to linear interactive stories. Often, a quite specific reaction would be more adequate. In the robbery example, the robber could violently fight off a possible attack of the user, reinstating that resistance is futile.

But what happens with exceptions that the author did not foresee? Either they are irrelevant and can be done without interfering with the story (like aimlessly wandering around or taking up garbage), or they should plainly be impossible[56]. A user should never be able to destroy the story – even if that means to openly show where the limits of linearity are. Chances are good that users will forgive minor limitations (see chapter 1.1) – and if many users stumble upon major limitations, the story probably wasn't written well enough.

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[56] In most environments for creating simulated interactive worlds, this is easy. Most things that have not been anticipated by the designers are not possible anyway because no one implemented them. Still, authors should take some time to think about the implications of implemented features. If, for example, the environment includes the functionality randomly destroy objects, key objects like letters with vital information should be excluded from this functionality.

4.1 Example

For illustration, here is a short example. The story is written in second person, to avoid endless repetitions of "the user character" and to make it easier to imagine experiencing this in a simulated world.

4.1.1 The Linear Story

Introductory text: *You and Ben are old friends. You have just met each other for the first time after quite a long period. Ben is on a business trip which led him on a route crossing your state. He planned a short detour to visit you and catch up with the old times. You reserved a table in a local restaurant on your family name, Smith, and just arrived there.*

You are now standing in the restaurant entrance. This is the area where all guests are welcomed. It also shields the dining area from all those unlucky souls who did not get a reservation but try to get a table anyway.

A thin lectern holds the guest list for tonight. A waitress waits behind it, idly trying to look as friendly as possible. Behind it is the dining room. It is crowded with people and there seems to be almost no table left.

You tell the waitress that you reserved a table. The waitress nods and signals you to follow her. You and Ben follow her to the table and sit down.

You and Ben talk about the good old times. Ben boasts a little with his successful career and even brags about saving someone with a cardiac massage

> once. He tries to hide his bragging by playing it down, saying that you just have to hit somehow on the chest and that anyone could do it. Still, you notice his pride. The waitress brings the menu and you order some drinks.
>
> While you discuss the menu, Ben's expression suddenly changes. He becomes unresponsive and collapses to the ground.
>
> You immediately begin with resuscitation, by turning him on his back, and giving him a cardiac massage. After some time, Ben regains consciousness.
>
> Shortly thereafter, an ambulance which was called by another guest arrives. They check Ben and take him to the hospital after congratulating you for your quick reactions and excellent first aid. Thanks to you, Ben will survive his heart attack.

This short story uses several of the techniques described in chapter 2. For one, it starts with a script (see chapter 2.2) which should be known to virtually everyone: the famous restaurant script. Then it changes to a resuscitation script. This script should also be widely known since most people have participated in a first aid class at one time in their life. The emergency also introduces time pressure which supports schema and script-based thinking (see chapters 2.1.2 and 2.2.1).

By letting Ben mention his previous experience with resuscitation, the user is primed (see chapter 2.5) for what is about to come. In this example the priming is temporally very close to the emergency where the user has to give first aid herself. This should be very effective, but is also rather obvious. In a longer story, the priming could be placed less obviously with some distance to the real event.

Simultaneously, Ben's claim that cardiac massages are not that hard raises the user's expectancy (see chapter 2.6) to be able to perform such a procedure herself. This again increases the chances that the user will indeed engage in the procedure later in the story.

4.1.2 Identifying Potential Exceptions

At first, let's look out for possible timing exceptions. In this short story, there are two points where timing becomes important enough to deal with exceptions. The first is when the waitress is waiting for the user to order something to drink. The second is when Ben lies dying on the ground, waiting to be reanimated.

There is also a potential freeform exception. The user might walk into the dining area without informing the waitress about the reservation.

Of course, one might imagine plenty other freeform and timing exceptions, for example if the user just walks away from the dying Ben. However, these are not very probable and are therefore excluded. In practice it would be recommended to monitor the behavior of users in early prototype tests and include more exceptions if needed.

4.1.3 Countermeasures

Having identified all potential exceptions, we can now create countermeasures to keep the story going in those cases.

It is possible that the user might try to walk into the dining area without telling the waitress about her reservation. In that case, the waitress can simply step in the way of the user and ask if she has a reservation. This leaves little more options than to reply with "Yes, on Smith"[57]

If the user does not order a drink after 20 seconds, just let the waitress say that she will come back later when the user has made up her mind. Since the story will take a dramatic turn with Ben's collapse, the waitress won't come back for drinks and the problem will not occur again.

Dealing with an inactive user when Ben is waiting to be rescued is more difficult. Being a more complex problem and a central point of the story, a cascade of guides would be useful.

[57] Or anything equivalent, like a corresponding menu option, depending on the dialog system used in the actual implementation of the system.

At first, if no progress towards Ben's rescue has been made after 10 seconds, let a guest shout "Does anyone know how to perform resuscitation?" This is again a form of priming which hopefully gives the user the necessary motivation to start with the cardiac massage.

After another 20 seconds of inactivity, let a guest take his cell phone and call 911. The guest then relays the instructions of emergency doctor: "They say we need to turn him on his back and start a cardiac massage. Someone turn him on his back!" The other guests hesitate, giving the user the chance to act. If she acts, the guest with the phone can relay step-by-step instructions how to perform the cardiac massage so that the rest of the procedure can be easily performed by the user. The emergency doctor is a figure of authority (see chapter 2.7) whose instructions the user will be very likely to follow. The step-by-step instructions should be very detailed and not be described in high-level terms, because reanimation is a difficult task and actions should therefore identified at a lower level (see chapter 2.4).

Finally, if the user still stays inactive (which should already be very unlikely), another guest steps in and performs the first aid instead of the user. This effectively makes the user a passive observer, so this should only be used as the very last resort to save the story as a whole.

5 Conclusion

Linear interactive storytelling offers a number of advantages like authorial control, minor authorial complexity and manageable authorial load while preserving an immersive feeling for the users.

This thesis has shown a variety of new authoring strategies, rooted in psychology, to author linear stories which match the actions of the users. These strategies can not only be used to create "pure" linear interactive stories, but might also help to reduce complexity in non-linear approaches and other story-intensive environments.

There is still room for future research, though. First of all, an actual implementation of a linear interactive story would be great to evaluate the concepts with real users. Such a prototype would also be useful to analyze which effects computer mediation will have on the psychological concepts which originally have been described for human beings in the real world.

The largest open research field is probably the management of possible deviations. Non-linear storytelling systems provide valuable techniques in part, but so far a fully convincing framework that can be adopted for linear stories is still missing.

Fortunately, a complex story adaptation framework is not absolutely essential. With a simple exception strategy and a well written plot, linear interactive stories should be realizable in many environments. After all, a well written story is the best drama manager…

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